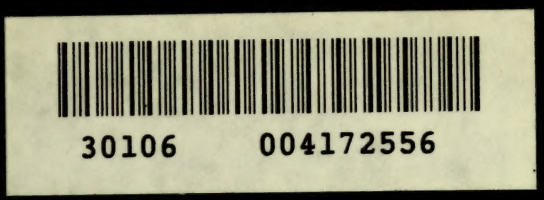
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A SYSTEM

OF

PRACTICAL THERAPEUTICS.

EDITED BY

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VOL I.

GENERAL THERAPEUTIC CONSIDERATIONS—PRESCRIPTION WRITING
REMEDIAL MEASURES OTHER THAN DRUGS—PREVENTIVE
MEDICINE—DIATHETIC DISEASES AND DISEASES
OF NUTRITION.

WITH ILLUSTRATIONS.

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PREFACE.

THERE is an art as well as a science in Medicine, and all the labors of the distinguished investigators who have by their discoveries within a generation transformed etiology, symptomatology, pathology, and pharmacology would be of little benefit to mankind if the practitioner had not found their application in therapeutics. To the physician and his patient the treatment of a disease is the one essential subject of study to which all others are subservient. It is the art of healing which must be exercised, and he is the most successful who is most fully acquainted with all the resources and methods which bedside and laboratory experience have placed at his disposal.

It is, then, with the object of providing the practitioner of medicine with reliable and helpful information concerning the best and most recent methods of curing disease that this work has been undertaken. The advances made in all branches of medical learning during the last few years have rendered therapeutic measures increasingly rational and complete, yet the extraordinary number of remedial agents which have been brought forward leads to a feeling of uncertainty in the mind of the practitioner as to when and how he can best employ each one. Further than this, exaggerated statements concerning new remedies are so frequent that only the few who have the opportunity to try them all can form correct ideas of their respective values. For these reasons it seemed to the Editor that a SYSTEM OF THERAPEUTICS embodying the views of those best qualified to discuss the subject of the treatment of disease would prove most helpful, and he feels that he can point with pardonable pride to the list of distinguished contrib-

utors whose articles afford a complete presentation of the therapeutic methods of the day.

With a view to completeness, surgical therapeutics has been introduced in the discussion of those ailments where such interference is indispensable, but, except in a few instances, the consideration of major operations has been excluded.

PHILADELPHIA,
222 So. FIFTEENTH STREET,
October, 1891.

CONTENTS OF VOLUME I.

PAGE

GENERAL THERAPEUTIC CONSIDERATIONS. By Horatio C. Wood, M. D., LL.D. 17

PRESCRIPTION-WRITING AND THE COMBINATION OF DRUGS. By Joseph P. Remington, Phar. D. 53

REMEDIAL MEASURES OTHER THAN DRUGS.

ELECTRO-THERAPEUTICS. By A. D. Rockwell, A. M., M. D. 133

THE REST-CURE FOR NEURASTHENIA AND HYSTERIA. By John K. Mitchell, M. D. 227

SWEDISH MOVEMENTS AND MASSAGE. By Benjamin Lee, A. M., M. D., Ph. D. 247

GENERAL EXERCISE. By Edward Mussey Hartwell, Ph. D., M. D. . 339

CLIMATE. By S. Edwin Solly, M. R. C. S., L. S. A., ... 385

HYDROTHERAPY AND MINERAL SPRINGS. By Simon Baruch, M. D. 453

PREVENTIVE MEDICINE.

GENERAL SANITATION. By Henry B. Baker, A. M., M. D. 535

DISINFECTION. By George M. Sternberg, M. D. 573

ANTISEPSIS AND ASEPSIS. By J. William White, M. D. 599

NUTRITION AND FOODS, INCLUDING THE TREATMENT OF OBESITY AND LEANNESS. By I. Burney Yeo, M. D., F. R. C. P. . 625

DIATHETIC DISEASES AND DISEASES OF NUTRITION.

PAGE

TUBERCULOSIS. By Solomon Solis-Cohen, A. M., M. D. 715

SCROFULOSIS AND RACHITIS. By Walter Chrystie, M. D. 927

ACUTE AND CHRONIC ARTICULAR RHEUMATISM, RHEUMATOID ARTHRITIS, AND GOUT. By James Stewart, M. D. 967

SCURVY. By John B. Hamilton, M. D., LL. D. 1001

DIABETES MELLITUS. By Frederick A. Packard, M. D. 1009

INDEX 1037

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GENERAL THERAPEUTIC CONSIDERATIONS.

By HORATIO C. WOOD, M. D., LL.D.

I HAVE found it somewhat difficult to decide the exact scope proper for a chapter which is to serve as the introduction to an elaborate encyclopædic work upon the Art of Treating Disease; but it has seemed to me that the questions which may with propriety be considered in such an introduction are—first, the different principles which underlie the modern Methods of Therapeutics, including a discussion of the way in which physicians have discovered the facts upon which these principles are based; second, Dosage; that is, the question of the amount of the remedies to be given, including the relative effects upon the human system of the same medicine in different doses, and the influences of idiosyncrasies or personal peculiarities, as well as of age, of sex, of habits of life, and other similar agencies, upon the action of medicine in various diseases; third, Rules for the Combination of Drugs which should govern the physician in combining medicines into prescriptions.

Therapeutic Methods.

There appear to my thought to be only four possible methods of Therapeutics: 1st, Empiricism; 2d, Treatment by some Law of Symptoms; 3d, Scientific Therapeutics; 4th, A combination of one or more of these three plans.

Empiricism.—The primeval method of treating disease was that which we now know by the name of Empiricism—a method that may be defined as the using of a certain remedy in a certain disease because it has seemed to do good in similar cases. From time to time, led by chance, by fanciful suggestions, by mental influences unrecognized by their subjects, men have given remedies innumerable and most diverse to persons suffering from disease, and when recovery has occurred it has been generally attributed to the remedy administered last. No substance so vile and disgusting, no procedure so violent and injurious, that it has not been empirically employed, while men have affirmed and reaffirmed its great value as a cure. It is true that careful observations repeated on many individuals may at last give a basis of prac-

tical truth and success to empirical treatment, but such method must remain, even after centuries of study, uncertain and unscientific.

Therapeutic Symptomatic Laws.—The constitution of the human mind naturally revolts against such unreasoning action as that of pure empiricism, and consequently from time to time, even in very early ages, alleged general therapeutic laws or theories have been promulgated. When it has so happened that such theory has led to practical success in some directions, the minds of men have often been subjugated by the appearance of truth. This is the explanation of the sway of the old doctrine of signatures, which taught that a remedy affects that organ which it resembles in appearance. Thus, the color of rhubarb led to its use in constipation, whilst that of aloes induced men to administer it in diseases of the liver. In either case the patient was often benefited, and the truth of the alleged law was proved to its votaries.

HOMŒOPATHY.—Of these mediæval dreams there is only one whose survival challenges our attention at the present time. This is the so-called Homœopathy, or Hahnemannism.[1] The essential doctrines of

[1] The question as to the causes of the survival of homœopathy is one of great interest. I believe the first successes of the practice were really due to the fact that the regular physicians of the day did much more harm than good, whilst the homœopathic practitioner, giving only infinitesimal doses, and thereby practically leaving his case alone, allowed Nature full scope. This explanation, however, does not apply to the present time. It seems to be true that homœopathy is everywhere now on the decline except in the United States, as is shown by the following statistics, whose accuracy has remained unchallenged, although they were published nearly two years ago:

Germany was the birthplace of Hahnemannism, but the Homœopathic Medical Directory, published in London, shows that in Germany there are only 218 homœopathic physicians. Recent official statistics prove that in Austria there are 7183 medical men, of whom only 118 claim any connection with homœopathy, and of these only 44 practise the system exclusively; there are none at all in the Italian districts, and but 19 in Vienna. The Homœopathic Directory already quoted shows that in 1875 there were in Great Britain and Ireland 269 homœopathic practitioners; in 1880 there were 275; in 1883, 260; and in 1889, 256—an actual decrease in the face of the enormous increase, not only of the general population, but also of the numbers of the regular profession.

For the remainder of Europe the homœopathic statistics are—Belgium, 41; France, 97; Denmark, 7; Russia, 71; Italy, 55; Portugal, 2; Spain, 131; Switzerland, 26. Therefore, according to the latest statistics, taken from homœopathic sources, there are on the continent of Europe 1022 practitioners of homœopathy—this in a population of at least three hundred millions of people! Surely a system which has attained such small proportions as this, and which is distinctly decreasing in its proportionate numbers, cannot be said to be on an ascending plane. It is very interesting to note that the largest proportion of homœopathic practitioners according to the population, on the continent of Europe, is to be found in Spain—the one country where the general level of education is the lowest.

In America, Hahnemannism is probably holding its own; the reasons for the difference in the two continents are probably multiple. In America individualism runs wildest riot; irregularities of all kinds in religion, philanthropy, and medicine flourish. More potent in promoting Hahnemannism in America, however, than the peculiarities

Hahnemann were originally three. The first of these taught that chronic disease is the result of a general poisoning of the system by a humor, which when it finds its way to the surface causes the itch. Microscopic investigation and the discovery of the itch insect long since gave a quietus to this theory. The second doctrine of homœopathy is that of so-called infinitesimal doses. This doctrine is not a simple affirmation of what every one knows to be true—namely, that certain substances are so active in their relations with the human organism that the least particle of them impresses that organism; nor is it a statement that all or any drugs in minute quantities exert an influence antagonistic to the effect which they produce when in large quantity.[1] The infinitesimal-dose theory, as propounded by Hahnemann, does inculcate that a substance like chalk, which is in large doses inert, becomes, under the influence of trituration and dilution,

of the people are the deficiencies of the regular profession, which grow out of the lack of legal control over entrance into medical practice: most potent of all factors, however, is the notorious fact that the American homœopath does not practise homœopathy—a fact which our readers may find abundantly proven, not only by the testimony of regular physicians who have watched the practice of homœopaths, but also by the resolution passed in 1878 by the New York Homœopathic Association, affirming, *inter alia*, "We shall exercise and defend the inviolable right of every educated physician to make use of any established principle in medical science, or any therapeutical fact founded on experiments and verified by experience, so far as in his individual judgment they shall tend to promote the welfare of those under his professional care;" and finally by the statements made during the last two or three years by prominent members of the New York Homœopathic Medical Society, who have publicly and repeatedly affirmed in the columns of the *New York Medical Times* that there are practically no homœopathic practitioners, and who, when contradicted, have proven that their contradictors themselves do not adhere to their professed belief.

Homœopathy has, in fact, practically ceased to exist. Certain practitioners of medicine, however, avail themselves of the value of the name as a trade-mark in order to deceive the public and obtain an advantage over their rivals. The time has, in my opinion, come when the regular physicians should no longer, by refusing to consult with homœopathic practitioners, recognize their separate existence. If such a practitioner desires a consultation, he in so doing publicly states that he is on the same platform as the man whom he wishes to consult with; and if consultations between homœopaths, so called, and regular physicians became frequent, in a short time it would be impossible longer to deceive the public. Moreover, the habit of truth-telling would have a very palpable effect upon the homœopathic doctors themselves. Self-respect would soon lead them to tell the truth at all times. In my opinion, the regular profession not only has it in its power, but owes it as a duty to itself and to the public, to announce once for all that homœopathy having ceased to exist, and there being no class of medical practitioners whose practice is based "upon exclusive dogma, the rejection of the accumulated experience of the profession, and of the aids actually furnished by anatomy, physiology, pathology, and organic chemistry," therefore that every physician is at liberty to consult with whomsoever he pleases. By doing this the American Medical Association and other similar representative bodies would simply leave it to the individual doctors to consult when they wished to, but would not take away the right of any man to refuse consultation with an individual on the ground that he was a hypocrite or otherwise immoral.

[1] For discussion of this doctrine in detail, see "Dosage."

possessed of intensely active properties, as though there were liberated from it a spirit of healing which had been imprisoned in its material grossness. More than this, Hahnemann taught that it was possible by the mere violence of the trituration to potentize almost to infinity. In his *Lesser Writings* he says: "If we wish, for example, to attenuate a drop of the juice of sundew to the thirtieth degree, but shake each of the bottles with twenty or more succussions from a powerful arm in the hand of which the bottle is held,—in that case this medicine which I have discovered, the specific remedy for the frightful epidemic, whooping cough of children, will have become so powerful in the fifteenth attenuation (spiritualized) that a drop of it given in a teaspoonful of water would endanger the life of such child; whereas, if each dilution bottle were shaken but twice (with two strokes of the arm), and prepared in this manner up to the thirtieth attenuation, a sugar globule, the size of a poppy-seed, moistened with the last attenuation, cures this terrible disease (whooping cough) with this single dose, without endangering the health of the child in the slightest degree." In other words, Hahnemann taught that the activity of a medicine depends upon the number of times it had been shaken, and that medical inertness by excessive shaking may become converted into almightiness. Remembering the numbers of the followers of Hahnemann, surely the bitterness of Carlyle, when he says, "Where ten men are gathered together there are nine fools," seems justified.

It is the third doctrine of Hahnemann which has been and still is the rallying-point of his followers, and which is claimed to be the fundamental truth of his teachings; this is the so-called law of *similia similibus curantur*, in accordance with which a symptom produced by a disease is to be cured by a small dose of a remedy which, when given freely to a healthy man, will cause the same symptom. Strange, is it not, that this alleged law, which has made immortal the name of Hahnemann, was not originally framed by him, but is plainly stated in the works of that really great man—Hippocrates? For two thousand three hundred years this generalization has survived; it must possess some peculiar vitality, some measure of truth, and I myself believe that as a rule of practice it will at times lead to a good result. As illustrating the subject let me suppose a case of vomiting. Ipecacuanha when given in large doses will cause vomiting, but under certain circumstances when administered in minute quantity it will relieve vomiting. Witnessing such administration and such triumph, the bystander cries, "Great is *similia similibus curantur*, and Hahnemann is its prophet!" But a second case of vomiting appears which is increased by ipecacuanha and is relieved by opium, which does not vomit when given to the normal man in large doses, but makes him insusceptible to the action of emetics. Now the upholder of the doctrine of *dissimilia dis-*

similibus curantur cries, "Behold, I have the truth: the remedy which produces the opposite to the symptom is the remedy to relieve the symptom."

It is plain that neither in homœopathy nor in allopathy, neither in the doctrine of similars nor in the doctrine of dissimilars, is there the whole truth. A law of nature has no exception, and if exceptions be found to an alleged law, it is plain that the law is only an allegation and not a reality. If we were to find that at times weight disappears, that objects not under the influence of some opposing force or resistance fail to fall to the earth, then we would know that the Newtonian generalization of the attraction of gravity was not a law of nature. Neither allopathic nor homœopathic doctrines are laws; they are mere expressions of coincidences, each of them base coin gilded with just sufficient of truth to pass current with the ignorant and unwary. Symptoms are the mere surface play of disease, marking only with great uncertainty the currents, whirlpools, and rocks that lie hidden far underneath. Symptoms apparently the same may be the outcome of entirely different bodily conditions. Any system of treatment based directly and immediately upon symptoms must be untrue. It is not possible to find any therapeutic law which shall directly relate symptoms to remedies, and enable the practitioner in ease and ignorance to combat disease.

Scientific Method.—The third possible method of treating disease may well be spoken of as the scientific method. In a few words it may be described as being based upon a knowledge of what it is necessary to do in disease; an acquaintance with the power of the forces at hand; and an application, by the ordinary processes of reasoning, of such forces to the needs of the occasion. Unfortunately, we are at present unable thoroughly to carry out these scientific methods in therapeutics, because our knowledge of the disease-processes and our knowledge of the forces at command are each imperfect. Sometimes it may be the fault of the therapeutist, but more often I believe that the difficulty lies with the pathologist and the student of the natural history of the disease. We cannot explain how salicylic acid does good in rheumatism or how mercury does good in syphilis, because we have no knowledge of the essential nature of rheumatism or of syphilis. Every advance of pathology is rapidly followed by a corresponding advance in therapeutics. The powers of quinine in malaria were recognized many years ago by the therapeutist, but not until the pathologist discovered that malarial disease is due to the presence of an organism could the therapeutist know that quinine cures malaria by killing this organism. The discoverers of the influence of bacteria upon the human organization were followed almost at once by therapeutists who pointed out the brilliant results of disinfection and of antisepsis.

In any attempt at the creation of a scientific therapeutic system the

foundations must first be laid by an elaborate, exhaustive study of the natural history of disease when left to itself. For the purposes of discussion, and indeed of practical therapeutics, this study may be considered under four headings: first, the cause of the disease under study; second, the course and the result of the disease; third, how in fatal cases the result is brought about; fourth, the basal conditions which underlie the symptoms of the disease.

Indication.—Before, however, taking up these points seriatim, and showing their relations to the treatment of individual cases, it is necessary to define one term which is much employed by writers on therapeusis. The term "indication" is used by the therapeutist as equivalent to "the pointing of Nature for relief." Thus, a broken bone—that is, the removal of the internal support of the limb—indicates the use of splints, or, in other words, of external support; and constipation, or retention of fæces, indicates the use of a purgative which shall cause expulsion of the retained material. These are very simple examples, but in many cases the indications are discovered with much more difficulty, and the practical success of the physician will often depend upon his skill in reading them. In many instances the indication is not for a single remedy, but for several, which by acting together will produce a combined result not obtainable through the action of one of them.

Cause.—In studying the cause of an existing disorder for therapeutic purposes, it is first necessary to decide whether such cause has already ceased to act, or whether it is still existent and persistent in its influence. When the cause has been a fleeting one, no indications exist in regard to it; when the cause persists, however, the indication is for the removal of the cause. Very often we have no power, especially in acute disease, to fulfil this indication; but when we can accomplish the removal of the cause, then are we most successful as therapeutists.

Chronic diseases are frequently produced by improper habits of life, and the alteration of such habits is most urgently demanded. Alcoholism and chronic lead-poisoning are further instances of affections in which the immediate removal of the cause—first, by the prevention of the absorption into the body of more of the poison; second, by the elimination from the body of all that therein exists—is most imperative. Again, when we disinfect a wound, destroy a malarial organism by quinine, or kill a tape-worm by kooso we are carrying out the indication for the removal of the cause.

Course.—To the therapeutist a knowledge of the course of any disease, whether its continuance is definite or indefinite, whether its tendencies are toward health or toward death, is vital. Very rarely can an acute disease which has a definite course be arrested or put aside by any therapeutic measure; and in such cases there is a strong nega-

tive indication for the withholding of any attempt to arrest the disease. Active interference will, under such circumstances, usually do harm. This is especially true when the natural tendency of the disease is toward recovery. When, however, the tendency of the disorder is very strongly toward death, the arrest, if possible, must be had at all hazards. Thus, in a case of malignant ulcer or of hospital gangrene or of cancer the overwhelming indication is to remove the affected part, even if it can be done only at a considerable risk.

Method of Death.—When, especially in an acute disease, a fatal result sometimes occurs, it is a matter of the gravest importance to decide the way in which such result is produced, so that if possible it may be warded off. Thus, in typhoid fever we know that death is usually produced by exhaustion; hence the indication throughout an attack of typhoid fever is to combat exhaustion by absolute rest, by proper feeding, and by moderate stimulation. We know also that the fatal result may be produced by a local ulceration, and be greatly aided by excessive diarrhœa; hence the indication to soothe irritation and arrest excessive secretion by careful regulation of the diet and by the use of properly-selected local sedatives. Again, in typhoid fever the exhaustion may be greatly increased by changes in the tissues produced by an excessively high temperature; hence the indication for the use of antipyretics and external cold, it being remembered that these agents are not to be employed in a routine manner in all stages or even in every case of the disease, but are to be used simply to meet one indication as it arises; that is, to keep down the excessive heat.

To take a second example of the way in which indications are to be drawn from studies of disease: during the forming stage of a sthenic pneumonia there is a local vaso-motor paralysis in the affected lung, with a great excess of blood in the part, and the indication is, if possible, to withdraw blood from the lung. For this purpose large doses of a remedy which will quiet the excited heart-action, and at the same time paralyze the general vaso-motor system, are indicated. Such a drug is found in veratrum viride. Under its influence the heart-force is greatly reduced, and, what is more important, the widespread dilatation of the vessels throughout the body equalizes the vaso-motor condition everywhere and causes the withdrawal of the blood from the congested lung. It must be remembered that the abdominal blood-vessels are so large that when thoroughly relaxed they are capable of holding the blood of the body, and when this relaxation is obtained in a forming pneumonia by the use of a drug the patient is, as it were, bled into his own vessels. The result obtained is similar to that formerly reached by venesection, without the exhaustion which venesection produced. On the other hand, if consolidation has occurred in a pneumonia, one grave danger is failure of power in the right side of the heart. Possibly one-sixth or one-

fourth of the blood-channels through the lungs are practically closed, and the work required of the right heart, in order that the blood may be forced through the narrowed space, is much beyond the norm; this, too, at a time when the heart is suffering from the exhaustion of a severe general illness. Under these circumstances a cardiac depressant would immensely increase the danger. Now the indication is for a cardiac stimulant—a drug which, like digitalis, shall quiet the heart (irritated by these excessive calls upon it), lengthen the diastole, so that the ventricle can thoroughly fill itself with blood, and finally so strengthen the systole as to enable the heart to force the blood through the narrowed channels in the lungs.

Basal Conditions.—In carrying out the indications which have been spoken of in the last paragraph the therapeutist is simply affording relief by the treatment of certain symptoms whose tendency it is to do harm. More important than these in most cases are those therapeutic measures which arise out of the correct understanding of the basal conditions of body which underlie the symptoms. The proper recognition of such conditions is, in individual cases, of the gravest importance and often of great difficulty. The real nature of the bodily state having been made out, it is generally easy to remedy it. Thus, in any given case of heart disease the diagnostic problem for the purposes of treatment is not as to whether this valve or that valve is diseased, or whether the heart-muscle is weaker or stronger than in health, but whether the normal relation between the heart-muscle and the work required of the organ is preserved. Thus, in a supposititious case the leakage in the valves may necessitate the putting out by the heart-muscles of twice the normal amount of force in order to maintain the balance of the circulation, and yet the heart-muscle has only been increased in its power one half. Under these circumstances, although there is an absolute hypertrophy of the cardiac muscle, the basal condition is one of cardiac weakness, because the increase of heart-power has not kept pace with the increase of heart-work. The absolute cardiac hypertrophy is in fact a relative cardiac weakness, and the indication is for a cardiac tonic and stimulant—an indication to be met by the use of digitalis or of some other similar drug.

To illustrate further the relations between basal conditions and treatment, let us consider cases in which the functional activity of an important organ is abated. Under these circumstances the diagnostician may find that all the nutritive supplies of the organ are less than normal. This being so, the indication is for a stimulant to nutritive activity. On the other hand, the diagnostician may find that functional activity is abated because the nutritive processes are in excessive activity, and then remedies which will soothe and quiet nutrition are demanded.

In interpreting any individual case of disease it must be borne in

mind that similar symptoms are produced by exactly opposite basal conditions. Thus, purging may be the outcome of intestinal paralysis or of intestinal irritation, whilst constipation may result from intestinal irritation or intestinal paralysis. An apoplectic unconsciousness may be due to arrest of circulation in the brain or to a sudden increase of blood in the brain. A furious delirium may result from exhaustion or may be a manifestation of a violent irritation of the cerebral cortex; and in like manner a convulsion may be produced by lack of power of the nerve-centres or may have its origin in centric irritation. If the temperature of the brain be lowered below the norm, as in heat-exhaustion, unconsciousness with muttering delirium is caused; whilst the excessive heating of the brain which occurs in thermic fever also often betrays itself by unconsciousness and muttering delirium.

In an individual case of disease the nature of the condition is to be recognized, not so much by a survey of the chief symptoms as by the careful consideration of these symptoms in connection with others which may seem of minor importance to the inexperienced, but which really mark the direction which the current takes. To discuss here in detail the subject of indications drawn from studies of the fundamental states in individual diseases would be out of place, but there are two conditions so similar in their manifestations, and so often mistaken, that it seems proper to say a word concerning them. These states are especially important, since they may exist in a single organ or in the whole body—*i. e.* they may be local or general. I refer to exhaustion and depression. In exhaustion power is wanting; in depression the power is preserved, but the system or organ is prevented from exercising it by the presence of some paralyzing agent. The strong man dying of starvation and the strong man tied with bonds illustrate the two conditions. In exhaustion help can only come through food and rest, and medicines are of value solely as they enable the system to get the rest or to appropriate the food. In depression food and rest are of subordinate importance, and it may well be that food shall really do harm, because the person is unable to digest. The indication is for a stimulant, for some medical agent that will overcome the action of the depressing presence.

Remedial Forces.—When the therapeutist has acquired the knowledge of the pointings of nature for relief in disease, he must next consider the forces which are at hand for the meeting of these indications. Prominent amongst these various curative forces are those embodied in medicinal substances, so that a study of the action of drugs upon the human organism in health and in disease is of the first importance. Such study, so far as the symptoms produced by drugs are concerned, may be made by administering to healthy men and women, in various but safe doses, the drugs which are to be tested, and by carefully observing the phenomena produced in accidental or intentional poison-

ing. In this way, however, we can only arrive at a knowledge of the symptoms produced by the medicinal agent, but when it comes to explaining these symptoms and to determining the exact method in which the drug acts, experiments are essential. In any science which is to be advanced by experiment the would-be investigator must have the power of varying the conditions of the experiments; otherwise no new points can be elicited. The physiologist cannot use man for the purpose of experiment; he must have an individual unit that can be sacrificed to the needs of science for the benefit of the human race. It is not only possible, but morally justifiable, to make these experiments upon the lower animals. As exemplifying the necessity of these experiments, let us suppose that the drug A slows the pulse. It may do so either by stimulating the inhibitory nerve or by a direct influence upon the heart-muscle or its contained ganglia. If we are confined to observations upon man, we can never determine in what way the drug slows the pulse. If, however, we are allowed to divide the pneumogastric or inhibitory nerves in the animal, the point can at once be decided. Or suppose the drug B causes convulsions. Are these convulsions spinal or cerebral? With man we can only infer; in the animal we can divide the spinal cord and give the drug, when, if the convulsions be cerebral, they will be arrested at the point of section of the cord, but if they be spinal they will occur throughout the entire body.

The value of direct studies upon the lower animals has been denied on the ground that drugs act differently upon man and the lower animals. Physically, man is certainly nothing more than a highly specialized animal, and it is inconceivable that his relations with the forces of the universe are altogether apart and different from those of less specialized animals. Nevertheless, it is true that many drugs do affect men differently from the way in which they act upon the lower animals. It is, however, true that there are differences among the lower animals in their relations to drug-forces. It is not possible, however, that these drug-forces are isolated from the rest of nature in being the subjects of caprice rather than of law, and it becomes the scientific therapeutist not to deny, but to seek out—not to say it is impossible to understand the relations of drugs to man and the lower animals, but to attempt to discover the laws which govern the apparent variations.

Enough of these laws are in sight to guide us in most cases. The first of these laws is that which I would call the *Law of Differentiation* —a law which is readily explained by stating that when an anatomical system is similar in its functions in different animals it is similar in its relations to drugs, but when its functions are differentiated, so also are its drug relations. Thus, in some animals the digestive system is

arranged for the digestion of vegetable food, in others for the assimilation of animal matters, and in man for the needs of an omnivore. Under such circumstances we see variations of the digestive system in its relations to drugs corresponding to the variations in structure and function. We can understand why elaterium, although it purges a man, fails to purge a dog. For this reason the greatest caution must be practised in using experiments made with drugs upon the digestive apparatus of the lower animals for the interpretation of their effects in man.

On the other hand, the function of the circulatory system is similar throughout Mammalia; and it is well known that veratrum viride, digitalis, and other drugs, which act especially upon the circulatory system, act upon the lower animals as they do upon man, function and drug relations in the circulatory system being alike uniform throughout all forms of animal life.

The second *law* is that of *Development*, by virtue of which when any anatomical system becomes more differentiated and developed it becomes more susceptible to the action of drug-forces. An exemplification of this law may be found in the action of opium throughout the animal kingdom. As is well known, this drug acts upon the frog almost as does strychnine, causing great spinal excitement and general tetanus, whilst in man its influence is especially noticeable upon the brain, causing sleep or stupor.

This difference of action has been one of those most harped upon as showing the hopelessness of the attempt to reason from the lower animals to man. If, however, the attention be directed, not to the two or three experiments at the extreme ends of vertebrate development, but to studies made upon the whole range of animal life, it will be found that there is a regular gradation of symptoms, the spinal manifestations becoming less pronounced and the cerebral symptoms becoming more marked as the scale of animal life is ascended. In the frog the spinal system seems to be proportionately more active than in almost any other animal; hence it is especially sensitive to the influence of opium. In the horse the brain and spinal cord are equally active and equally sensitive to the opium, and consequently the spinal and cerebral manifestations are about equal in opium-poisoning. In the dog the brain is more highly developed, and the cerebral symptoms of the poisoning begin to be more apparent; whilst in man the over-development of the brain makes it so susceptible to the drug that the cerebral symptoms surpass and overshadow the spinal phenomena.

The third *law* is that of *Acquired Habits*. It is with much reserve that I venture to suggest the correctness of the theory involved in this law. The object is to account for those cases in which certain drugs, especially certain narcotic drugs, have lost their influence upon various

species of animals. It is well known that the animal system becomes accustomed to the habitual use of vegetable narcotics, so that doses which in the normal individual produce severe symptoms can be taken with impunity. My present thought is that probably this temporary habitual influence has been acquired by successive generations until it has been permanently stamped upon the species, so that the drug has finally lost its influence not only upon the animal, but also upon its offspring. It is alleged that the Virginia deer can feed upon the tobacco-plant, and I have seen stated by apparently reliable authority that certain monkeys inhabiting the regions where the *Strychnos nux-vomica* grows are entirely insensitive to the influence of strychnine. I have frequently seen our domestic goats, haunting the purlieus of cities, eat with absolute impunity the stramonium-plant.

In stating these generalizations, which I have ventured to call laws, it is not presumed that they cover the whole field or enable us to explain every case of variation in the effects of remedies on various individuals. Whatever contradictions may appear to arise in the results obtained by experiments, it is certain that animal experimentation affords our only possible means of investigating the physiological action of medicines. Whatever difficulties may beset this path, it is the only one which can lead us to a scientific therapeusis. In following it we must acknowledge, first, as a fundamental axiom, that no amount of experimentation can overthrow a clinical fact, although when a contradiction between experimental and bedside observation seems to arise, such contradiction challenges the correctness of the alleged clinical and experimental facts alike, and should lead to a careful re-examination. It was discovered by Traube that digitalis increases the blood-pressure in the lower animals, which led to a doubt of the correctness of the then general belief that digitalis acts upon man as a cardiac sedative, and finally to the recognition of the falsity of the clinical observation upon which such belief was founded. The field of vision of the experimenter must not be confined to one species or to one set of animals, but the whole series of animal life must in detail be passed in review; and I believe that almost invariably a complete study of the clinical and experimental evidence will reveal a beautiful concord—that concord between experimental and practical medicine which so often fails to appear, simply because we cannot fit together the fragments of truth in our possession.

In the last twenty years therapeutics has grown enormously toward scientific accuracy and in scientific methods, and each year witnesses marked progress. Nevertheless, we are still hampered by our ignorance—an ignorance which, as has already been stated, is more often in the region of pathology than that of therapeusis—and we are therefore forced at present to mingle science and empiricism; so that the

best therapeutics of the day, the therapeutics which is to be inculcated in the present System, is a *mixture of science and empiricism.*

Dosage.

By the term *dose* is meant the amount of a medicine which it is safe or proper to administer to a human being. The doses which are given in textbooks on therapeutics of necessity differ considerably from those used in practical medicine. It is, indeed, not intended that these given doses should be considered as fixed quantities, but as average amounts, which are to be departed from to suit the needs of the individual case. The maximum dose of the active remedies, as given by the textbook, is or ought to be the amount which will produce slight but distinct symptoms in a normal individual: such dose is sometimes termed the Physiological Dose. Doses are sometimes spoken of as the Single, the Continuous, and the Daily Dose. The Single Dose is that which it is proper to administer at one time, without expectation of repetition. It is usually given for the purpose of producing an immediate effect, as in the administration of a purgative. The Continuous Dose is that which it is proper to administer when the remedy is to be repeated at shorter or longer intervals for the purpose of maintaining an impression upon the system. The whole amount of the added continuous doses, as given in the twenty-four hours, is spoken of as the Daily Dose. In administering remedies to make a prolonged impression it must be remembered that the effects, and especially the length of time which each dose acts, vary greatly according to the nature of the remedy, and especially according to its relations with the excretive glands. The vegetable alkaloids are usually rapidly absorbed and rapidly eliminated or destroyed, so that each dose acts promptly and there is no accumulation of the drug in the system. On the other hand, those vegetable remedies which are dependent for their activity upon glucosides commonly yield their active principles slowly to absorption; but when these principles are once taken into the body they are eliminated with great slowness, hence the liability of remedies of this class to have the so-called cumulative action—*i. e.* to exert, after long continuous use without much apparent effect, a sudden overwhelming influence. As an example of a substance possessing this cumulative action may be mentioned digitalis. It has been repeatedly denied of late years that this drug ever acts in this way, but I know from personal experience that it does do so. Thus, in a case in which it had been long administered in hopes of aiding in the absorption of a pleuritic effusion no effects were apparent until a certain Sunday, when the pulse fell from about 100 to 85. Although the drug was immediately withdrawn, the progressive fall of the pulse-rate continued, so that by Wednesday the heart beat only forty times a minute, and not until Friday did the

pulse-rate begin to rise toward the normal. The cumulative action of digitalis is especially liable to occur when the drug fails to increase the activity of the kidneys; that is, when it fails to be eliminated. A sudden cumulative action of digitalis is sometimes produced by a sudden absorption of it from the tissues where it has been stored. Thus, I have known cases in which digitalis had been given for a length of time for the relief of heart symptoms, in which "tapping" was finally resorted to on account of the excessive ascites, with the result that a day or two after the tapping there was an explosion of digitalis-poisoning. The explanation of this is very simple: the withdrawal of the pressure upon the outside of the abdominal vessels caused in them general relaxation, which relaxation in turn lowered the general arterial pressure throughout the whole system, and thereby favored absorption of the serum lying in the various tissues of the body. This serous dropsical fluid was, however, saturated with digitalis that had been gradually stored up in it, so that with its absorption there was a sudden pouring of digitalis into the blood, and as a necessary result an excessive action of digitalis; for it must be remembered that it is not the drug which is in the tissues of the body, but the drug which is in the blood-vessels, that influences the heart and nervous system.

Mineral substances are more apt to accumulate in the body than are those belonging to the vegetable kingdom. Arsenic, mercury, lead, and various other minerals are well known to be deposited in the tissues. Other mineral substances which do not yield insoluble compounds in the body, and are not therefore deposited in bone, muscle, or nerve-centres, nevertheless may accumulate in the various liquids and tissues, although after the cessation of their administration they are more or less slowly removed. Thus, when the bromides are given continuously they gradually saturate the system, and produce the so-called "bromism," a condition which rapidly disappears on abstinence from the remedy, because the loose, soluble bromide compound is rapidly taken up by the blood and thrown off by the kidneys. The effects of lead-poisoning, on the other hand, are permanent, because the insoluble lead compound remains in the tissues.

A knowledge of the relations between absorption and elimination in affecting the effects of remedies is of the gravest importance in practical medicine, and it is extraordinary that these relations are so often lost sight of in the administration of drugs. The generalization which naturally follows immediately upon their consideration is that not only the size, but especially the frequency, of the dose must be adapted to the usual rate of absorption and elimination of each individual drug, as well as to the effects desired upon the system. The dose of a very fugacious agent ought to be given at very brief intervals, in order to have any steadiness of action. Yet how often is the whole matter for-

gotten! As an every-day example take an ordinary cold or mild bronchitis. Certainly in this affection a steady impression is desirable. Nevertheless, for the relief of a cough hydrocyanic acid is often given in a mixture every three or four hours. The influence of this acid is so fugacious that, as is well known, the symptoms caused by a toxic dose usually disappear within an hour. The ordinary dose of hydrocyanic acid is so small as not to have any perceptible physiological action. If a very powerful toxic influence is over in an hour, how long will an imperceptible, intangible, and probably non-existing influence last? It is hardly necessary to point out in more detail the utter folly of giving the acid in the way commonly indulged in. The matter is much more serious in the employment of remedies which have more positive influence upon the system than has hydrocyanic acid in therapeutic doses. The action of an ammoniacal salt is almost as fugacious as that of hydrocyanic acid, yet how often are ammoniacal remedies given in large doses at intervals of three, four, or even five hours!

This habit of giving at short intervals powerful remedies whose influence is short lived I have sometimes in my lectures called the "*kangaroo*" *method*, the name being suggested by the thought that such treatment consists in a series of great "hops"—a stimulation or depression of the system or organ, as the case may be, in one hour, to let it drop back the next to the old level.

When absorption and elimination of a drug take place slowly, the intervals between administration may well be lengthened. Thus, it is rarely necessary to give digitalis oftener than once in four hours. Again, when the full influence of the drug is only reached by bringing about an accumulation of it in the system, the intervals may be very long. As an example a case of epilepsy may be taken in which mild bromism has been produced. In such a case, from the bromide pool, to use a metaphor, in the system there is a constant slight leakage throughout the whole twenty-four hours by elimination, but the loss from the pool can as well be made up by additions by two doses in the twenty-four hours as by doses at shorter intervals, because the single dose is so small in proportion to the mass in the system that its immediate influence in raising the surface of the pool is not perceptible. The constant taking of medicine is to most people very disagreeable, and in epilepsy it is wisest to avoid the annoyance of the frequent repetition of the dose.

During the last few years an attempt has been made to establish a therapeutic law or guiding principle, which, although not identical with the law of "similars," as inculcated by Hahnemann, has close relation with it. This alleged law may be formulated as follows: All medicinal substances, when given in small doses, produce results precisely opposite to those which they cause when administered in large doses. In my opinion, the only novelty that there is about this allegation is in

the absoluteness and dogmatism with which it has been made. It has been known from time immemorial that the symptoms produced by small doses of *certain* drugs, especially by those drugs which we consider stimulants, are the reverse of the symptoms caused by large doses of the same drugs. It cannot be denied that ammonia, alcohol, and ether excite cardiac action—*i. e.* increase functional activity—when in moderate amount, although when in large quantities they arrest the heart in diastole—*i. e.* paralyze functional activity. On the other hand, there is not the shadow of proof as yet that *all* drugs act differently in large and small doses. Aconite, so far as we know, depresses the heart-muscle whether in small or large amount, whilst digitalis augments the functional power of the heart-muscle until at last cardiac arrest takes place in spasm. As did Hahnemann, so here also does it seem to me that these new therapeutic generalizers have mistaken a partial truth for a whole truth, and made a generalization based upon symptoms instead of upon bodily conditions. There must be some differences between the action of a remedy which, like ammonia, first increases and then decreases functional activity, and one which, like digitalis, creates a spasm which abides to death; and it may well be that certain forms of functional excitement naturally end in paralysis without there being change of kind in the condition of the affected part.

The old doctrine that excess of stimulation ends in arrest of function affords a wiser way of putting the matter than the new method of statement, because what is true of drugs is also true of forces. A moderate heat stimulates activity; an intense heat paralyzes it. A feeble electrical current contracts the muscle; a sufficiently powerful one paralyzes it permanently. It would seem, however, that even this generalization is not correct, for there appear to be stimulants which in excess fail to paralyze.

I do not think it necessary to occupy more space with a discussion of this matter. We are not near enough to the knowledge of the real methods of action of drugs to make any fundamental deductions; all attempts to build up a system of therapeutics upon such more than doubtful generalization must remain for a long time to come futile. The practical therapeutist must, however, always keep in remembrance the fact that many remedies act differently in different doses, and must accordingly apply his knowledge in treating individual cases of disease. The different actions of different doses are sometimes seemingly antagonistic, but not rarely they are for practical purpose entirely different in kind, having no apparent relations. Thus, as is well known, a small dose of alcohol acts chiefly as a digestant when given with food, enabling the stomach more readily to assimilate; a larger dose of alcohol acts as a general stimulant; an overwhelming dose as a paralyzant both of the nervous and circulatory systems. In the same way, a small

dose of quinine may be of service as a stimulant to the stomach and to the general nervous system; in a larger dose the alkaloid is given as an antiperiodic for the purpose of arresting malarial disease, whilst by some therapeutists enormous doses have been administered for the purpose of depressing the circulation and the general system, and thereby obtaining relief in inflammatory conditions.

Physical State of Patient.

The physical states of patients, as well as their environments, so greatly influence both the effects of medicine and the size of the dose proper to be employed that it seems necessary here to devote some pages to their consideration. For the purposes of discussion these general conditions are best arranged under the headings: Age and Sex; Time and Method of Administration; Emotion; Temperament; Idiosyncrasies; Climate and Habits of Life; Disease.

Age and Sex.—For the purposes of physiological experimentation, especially when it is intended to determine the minimum fatal dose of a remedy, great accuracy of dosage is required. It is evident that in an animal weighing one hundred pounds the amount of blood, and consequently the dilution of a given dose of a drug after absorption, must be greatly in excess of what it is in an animal weighing ten pounds. Domestic animals, of the same breed, often differ extraordinarily in their size. For these and other similar reasons the physiologist always gives the dose of a drug as so much per pound.

In human medicine we do not expect such extreme accuracy of dosage, and the difference of weight between individuals is not so great. Consequently, the therapeutist very rarely speaks of the dose per pound. At the same time, in the case of extremely small or extremely large persons the dose should be altered from the average standard. The difference between the weight of the child and the adult is very great. Partly from this fact, and partly because some portions of the organization of the young are more susceptible than they are in adult life, the necessity arises for a very careful adjustment of the dose in the cases of children. The late Professor Clarke proposed a plan according to which the dose is to be graded by the weight of the child. One hundred and fifty pounds was taken as the weight of an average human adult, and in order to obtain the fractional dose this number served for the denominator of a fraction whose numerator corresponded to the weight of the child in avoirdupois pounds. Thus, the formula for a child fifty pounds in weight would be $\frac{50}{150}$ or one-third of the dose for the adult. A theoretic objection to this rule is that though it attempts scientific accuracy, it makes no allowance for the difference in susceptibility in the different anatomical systems in youth and in age. A more important practical difficulty is found in

the fact that very frequently the physician does not accurately know the weight of the child. In actual practice the arbitrary rule of Dr. Young is the one which I think is almost universally adopted in this country and in England. According to this rule, the fraction for the child is found by the formula of $\frac{\text{age}}{\text{age} + 12}$. Thus, if a child were four years old, the proper dose would be $\frac{4}{4 + 12} = \frac{1}{4}$th of the adult dose. In the formula of Cowling, still sometimes used, the fraction is, $\frac{\text{age next birthday}}{24}$; according to this, the dose for a child approaching four years of age should be $\frac{4}{24} = \frac{1}{6}$ of the dose of the adult.

It will be seen that these formulas give quite different results. I think that that of Dr. Young is, on the whole, the more accurate, but in applying it the practitioner must remember that it is an arbitrary rule with numerous exceptions. In the case of purgatives the dose should usually exceed that allotted by the Young rule. Thus, for a child four years old a dessertspoonful of castor oil would not be an overdose, whereas the dose should be a teaspoonful according to the rule. On the other hand, with remedies which powerfully affect the nervous system the dose should usually be much below that given by Young. Thus, in a child two years old the fraction by Young's rule would be $\frac{1}{7}$, which would give as the ordinary dose of laudanum 4 drops, an amount certainly dangerous.

As old age is approached the human nervous system usually becomes less sensitive, and hence feels less acutely the effects of narcotics; hence, morphine and similar drugs can be used more freely than during middle life. On the other hand, depressing influences are less stoutly resisted, and hence the use, and especially the doses, of all depressing drugs should be more and more restricted. During progressive failure of the physical powers stimulants are very well borne, and should be employed more freely than in earlier life.

In regard to the influence of sex upon dosage, it is hardly necessary to point out that woman is not only smaller, but, at least in this country, more sensitive than man, and that therefore the proper doses for her, especially of depressing or perturbating medicines, are smaller than for man; also, that the dominating influence of her sexual life must never be lost sight of. During menstruation it is often well to suspend active medication, and always imperative to avoid disturbing the general system without due cause. During pregnancy emetics are of course strongly contraindicated, as are also remedies which have a distinct tendency either to irritate the kidneys or to depress the vital forces.

Time and Method of Administration.—The time and method of

administration of remedies are chiefly of importance, because by a knowledge of these facts we can gain information as to the rate at which the remedies are absorbed and as to the influence which they exert upon the tissues through which they find entrance into the body. As portals for the admission of medicines into the human body physicians have the stomach, the rectum, the lungs, the skin, and the cellular tissues under the skin.

The most general rule for the administration of a medicine is that the drug must be given by the mouth, unless obvious reasons exist for not doing so; so that the dose given in the textbooks is that for use by this entrance.

The solvent powers of the gastric and intestinal juices are so great that few medicinal substances refuse to yield to them.

The form in which the remedy is administered has much to do with the rapidity of its absorption. Usually, but not always, a substance in solution or a soluble preparation is more rapidly taken up in the stomach than an insoluble one. Certain solutions are, however, precipitated by the gastric juices; as examples may be mentioned a number of the soluble salts of iron. If the active principle be in solution, it will commonly be more rapidly absorbed when the stomach is empty than when the viscus has food in it; if, however, the drug must be dissolved in the stomach, it may well happen that absorption takes place best after a meal. Medicines which are locally irritant are best given when the stomach is full, so that they may be diffused through the mass of food, and not come in contact with the mucous membranes in concentrated form. On the other hand, if it be desired to affect the stomach locally, it is better to give the remedy when the viscus is empty. Thus, in chronic inflammation of the stomach nitrate of silver should be administered half an hour before meals; but when, as in epilepsy, the expectation is to affect the general system, the silver salt ought to be exhibited after meals. When the mucous membrane of the intestines is to be reached, it is commonly better to give the remedy at a time when the natural flow of partly digested food from the stomach into the intestines is in fullest activity. Thus, in gastric irritation the subnitrate of bismuth should be administered half an hour before meals; in intestinal irritation at from one to two hours after meals.

When *rectal injections* are given the fact should be remembered that the general office of the rectum is to throw out rather than to absorb, and that its juices are alkaline in their reaction and have very feeble solvent powers. Medicines are therefore taken up from the rectum with difficulty and great slowness, and when rapidity of effect is desired this channel should not be employed. If it require half an hour for the absorption of a certain alkaloidal salt from the stomach, about fifty minutes should be allowed for absorption from the rectum. It has

been the habit of many physicians to make the rectal dose of medicine one-half greater than the dose by the mouth. The chief value of rectal medication is for the purpose of influencing the rectum itself or the neighboring organs. The preparation of the remedy used must be small in bulk and free from irritant properties, otherwise it is rapidly rejected.

When the remedy is suitable and properly prepared for exhibition by *hypodermic injection*, it is absorbed much more rapidly than when given by the stomach. If half an hour be required for the gastric absorption of a medicinal principle, fifteen minutes will probably suffice for absorption through the cellular tissue. The hypodermic dose may be set down as commonly about 20 per cent. less than the stomach dose. This difference arises partly from the greater rapidity of the absorption, but probably also, in part, because alkaloidal salts are to some extent destroyed in the liver, so that only a portion of the remedy reaches the general system after its absorption from the stomach.

There are so many objections to the hypodermic method of medication that it should not be employed unless for obvious reasons. There is always a possible danger of throwing the entire dose into a vein, and consequently into the right side of the heart in a concentrated form. I once injected one-sixth of a grain of morphine into the arm of a woman, who within two minutes fell back unconscious. The jaw dropped, the respiration ceased, and for a time I thought I had killed my patient. Moreover, local inflammations, abscesses, and ulcerations have resulted from hypodermic injections in innumerable cases. I believe that in a very large proportion of these instances, however, the local trouble has been due to an unclean hypodermic syringe. It is essential that the hypodermic solution and the syringe with its needle be thoroughly aseptic. It must also be remembered that the cellular juices are distinctly alkaline, and that therefore in the use of substances which, like quinine salts, are insoluble in alkaline solutions care must be taken to have the solution distinctly acid: vegetable acids are usually preferable to the mineral acids. Local inflammations are also much less apt to arise if the solutions are thrust boldly and deeply into the part, since when the injection is practised directly under the skin that membrane may be torn from its attachments sufficiently to interfere with its circulation. Distilled—or, better, recently-boiled—water should commonly be used as the basis of a hypodermic solution. Unboiled well, river, or other natural water must never be accepted, but alcohol is in some cases permissible. Thus, we have no concentrated watery preparation of digitalis, and when urgency exists the tincture may be employed. Ten minims of it will usually not cause serious local trouble. Nevertheless, it is only on rare occasions that the physician is justified in using any other drugs than alkaloidal salts hypodermically. Mercurial injections have,

it is true, been much practised on the continent of Europe, but I have seen death result from the local sloughing produced by calomel injections which had been given with the strictest attention to the minutest rules laid down by the highest European advocates.

The *endermic method,* or the absorption of drugs through the skin from baths, takes place with such slowness and feebleness that we cannot use this method for the purpose of impressing the general system. When, however, the skin is anointed with a fatty material containing a medicinal substance, absorption to an appreciable extent may occur; hence, inunctions, or rubbing with fatty preparations of active drugs, have been largely practised for the purpose of affecting the whole organism. It is important when inunctions are to be practised that the fatty material chosen be such as is best adapted to the purpose. Four substances are in common use: lanolin, cosmoline, ordinary fats, and more or less impure oleic acid.

Lanolin is chiefly a sebaceous substance, containing a large percentage of insoluble cholesterin; it is a natural fatty material that is thrown out for the purpose of rendering the hair of the animal soft. It is really of the nature of an excretion, which is not meant by nature to be absorbed, but to remain on the surface of the skin as a soothing, non-irritating emollient which shall render the skin and hair more pliable. Whilst, therefore, it is well adapted to be the base of an ointment intended to act locally on the skin, it is not a suitable vehicle when absorption is desired. Cosmoline is a mineral substance, the major part of which is composed of paraffin, which is very insoluble and probably incapable of absorption. Nevertheless, the more fluid oils which enter into the composition of cosmoline, and which probably are the solvents of the substances, probably aid the absorption of the drugs into the system; and certainly a cosmoline ointment is capable of impressing the organism. Experience, as well as *a priori* reasoning, indicates, however, that as a vehicle when absorption is desired cosmoline is inferior to the natural animal fats. The old objections to these latter substances are their liability to become rancid and the sense of "dirtiness" which attends their use. It is especially on the score of cleanliness that solutions of active principles in fatty acids have been praised under the term of oleates, and it also has been claimed for them that they act more promptly than true ointments. The efficiency of these oleates cannot be gainsaid, but they are more expensive than ointments, and have seemed to me to be more irritating to the skin; so that in my own practice I have gone back to the older preparations.

The use of the skin as a portal of entrance to the body is, after all, only rarely proper. Absorption takes place so slowly, and with so much uncertainty, that it is not possible to have any conception whatever of dosage. The only proof in a given case that absorption

has taken place is the production of the physiological action of the remedy.

Almost the sole advantage attached to the exhibition of medicines by the skin is the avoidance of the local action of the drug used upon the internal organs; but sometimes when it is desired to impress the system as rapidly as possible the drug is simultaneously given by the mouth, by the skin, and by the rectum.

Endermic medication is at present confined almost exclusively to the use of mercurials. In exhibiting these remedies it is essential to remember that they are locally irritant, and that a definite plan of administration must be arranged, so that no one portion of the surface of the body shall have the ointment applied to it two days in succession. It must also be remembered that some portions of the skin absorb much more rapidly than others. The following is a working schedule: Sunday, left arm-pit; Monday, left flank and groin; Tuesday, inside of left thigh; Wednesday, inside of right thigh; Thursday, right flank and groin; Friday, right arm-pit. When inunctions are to be practised twice a day, the backs of the calves of the legs may be interpolated in this schedule.

The anatomical arrangement of the lungs is such as to offer an enormous amount of surface and a very easy entrance into the absorbents; consequently, these organs afford the most open portal to the system, for entrance through which, however, a substance must be in the form of gas or vapor The lungs are not only adapted for rapid absorption, but also for rapid elimination, so that a gas not only enters through them with absolute freedom, but also is thrown out with almost equal rapidity when fresh supplies are no longer furnished. In these facts is to be found the cause of the rapid development and the fugaciousness of surgical anæsthesia.

When it is desirable to impress the system for any length of time substances which are not easily vaporable, and which therefore are not easily eliminated from the lungs, must be employed. It is only in the crises of an acute disease, when an overwhelming, immediate impression is desired, that the physician avails himself of this method of administration.

Atomization, or the pulverization or breaking up into fine spray of water with some substance dissolved in it, is an important medicinal process. It is not, however, well adapted for internal general medication, and is used only in order to obtain a local influence upon the mucous membrane of the air-passages. When it is desired to reach the upper passages, the spray may be a coarse one; but the lungs themselves can be affected only by a very fine spray thrown into them in large volumes during full inspiration.

Habits of Life, including Climate.—Whatever may be our belief

in regard to the Darwinian theory of creation, it is certain that the animal system adapts itself within certain limits to its environment, and that, therefore, habits of life have a profound influence upon the whole organism; and, as a further consequence, the relations of drugs to the individual are altered. Hard physical work, habitually kept up for years—especially when, as is generally the case, it is associated with habitual exposure to weather as well as to hardships of greater or less severity—produces a condition of the system in which disturbing influences are little felt until they become excessive in their power. On the other hand, refinement, luxury, and indolence naturally tend to the production of effeminacy and of a peculiar sensitiveness to disturbing agencies. The history of the human race everywhere teaches this lesson, and I am told by experienced veterinarians that it is almost as apparent in the lower animals, so that cart-horses and similar animals of low pedigree often continue to eat their oats whilst surgical operations are being performed on them which would make a thoroughbred racer scream with pain and plunge wildly about.

Any one who has passed through an apprenticeship in the wards of a great city hospital, chiefly given over to the care of the lowest orders of mankind, and gone out to practise amongst people belonging to the higher walks of life, must have learned the lesson that his customary doses frequently have to be reduced one-third, and even one-half, in order to meet the exigencies of his new class of patients.

Habits of life also modify the relations of the organism to drugs, in that they tend to the production of certain diseases. In malarial countries almost all diseases seem to require quinine. In hot climates depletion is very badly borne, and if we may believe recent statements even the relations of men and animals to anæsthetics are changed. In the moist, peculiar atmosphere of Japan rheumatism and neuralgia are extraordinarily rife; indeed, the tendency to the production of rheumatic diathesis is so intense that it is affirmed by high authority that even horses imported into Japan very commonly become disabled by rheumatic disease.

Among habits of life the constant use of certain drugs may well be considered as affecting treatment greatly. Especially must the practitioner be on his guard in respect to the effects of the habitual use of alcohol.

Doses of stimulants which would paralyze the ordinary individual make scarcely any impression upon the man who has long been used to taking a half pint of whiskey daily. Symptoms are so altered that in alcoholic subjects depressants often appear to be indicated when they are not, and even in the rare cases in which depletion really is demanded it is not safe suddenly to withdraw the daily dose of alcohol to which the subject has been long accustomed, and sometimes the best results are to

be reached by continuing the alcohol and at the same time exhibiting depressing remedies. In the presence of an acute disorder he would be a bold physician who would advise the breaking off of the opium habit. As is well known, it is always dangerous to withdraw opium abruptly from a patient who has long been accustomed to its use. The nervous system, which might have been able to right itself if a week or ten days is given to the withdrawal of the narcotic, not rarely falls into collapse upon an immediate withdrawal of its customary stimulus. Many physicians appear to forget the possibilities of a prenatal alcoholic or opium habit. Literature, however, shows that when the female opium victim brings forth a child, such offspring is prone within forty-eight hours to die of an apparently causeless collapse. The real cause of such collapse is, however, the need of opium. The child in the first few hours finds itself not only struggling with the new conditions of life, but also totally deprived of its nerve-stimulant, and it dies when its life might have been saved by doses of laudanum perhaps sufficiently large to kill an ordinary infant.

The power which the human system has of habituating itself to the influence of certain drugs is remarkable, especially when contrasted with the fact that the prolonged exhibition of certain other drugs seems to render the human frame more susceptible to their influences. The strangeness of the fact becomes still more apparent when it is recognized that even with a single individual drug like the iodide of potassium the system in some persons grows accustomed to its influence, whilst in other cases there is a gradual lessening of toleration, until finally the remedy cannot be given except in the most minute dose.

The laws which govern these peculiarities are at present unknown. It would seem, however, that vegetable drugs are more usually tolerated than mineral substances, and that in those cases in which the system becomes more sensitive to the action of a remedy there is usually either an accumulation of the drug in the body, or else the production of some local inflammation which is at the bottom of the intolerance.

It is often necessary for the physician to bear in mind the benumbing influence of "drug habit" in prescribing for cases which are essentially chronic. In such cases a drug which at first acts, it may be, most happily, often by and by loses its control. When under these circumstances the remedy is intermitted for a length of time, the sensitiveness of the organism to its influence usually returns. For these reasons the prescriber should substitute from time to time one remedy for another of the same class. Thus, in atonic dyspepsia after three or four weeks the extract of quassia may be replaced by the extract of gentian, and that in turn by the extract of chiretta, and so on; in chronic heart-failure, usually *before* digitalis has sensibly begun to lose its control, caffeine should be given in its place, and then strophanthus or adonidin may

be essayed, or digitalis itself given again; in chronic constipation the salines may be followed by a combination of aloes, belladonna, and strychnine, and this in time should give way to rhubarb and colocynth or cascara sagrada. Thus, one after the other may the changes be carried out until the end of the chapter.

Emotions.—There is a school of philosophers, numbering among them some of the world's greatest scientists, who affirm that mental conditions are symbols of consciousness of the changes which take place automatically in the organism; that we are conscious automatons; that feelings can have no causal efficacy, produce no functional excitement of the nervous system, and no changes either in action or in structure; that they are, as Mr. Hodgson says, laid upon the surface, having no more influence upon the part below than the superficial colors upon the stone of the mosaic, consciousness itself being nothing more or less than a sort of aura or collateral function of the nervous system.

As a student of psychology I believe that these ideas rest upon pure dogmatism and assumption, and as a practical physician I know that the therapeutist who acts upon such theories will fail in his treatment of disease; and I suppose that to practical men the strongest proof of the truth or falsity of a theory is the practical results which follow its being brought to the test of every-day life. According to this theory, emotions are without influence, being themselves purely results of nervous excitement, mere reflexes of peripheral stimuli. There is no reason for believing that an emotion can exist apart from consciousness, and every physician must know that the waves of unusual emotional excitement are capable of profoundly influencing the nervous system for evil. I have seen the fright produced by a loud clap of thunder cause a chorea which lasted for many months. Abundance of cases are on record in which an absolutely hopeless intellectual paralysis has been produced by the fright of a few minutes. Thus in a recorded case a girl, ready and apt, suffered rape and was left for life a hopeless idiot.

Without going further into this subject, because it is more or less foreign to the matter in hand, it suffices to reiterate that emotions have power for evil in their influences on nerve-matter, and that they also have power for good. When a resident physician in the Philadelphia Hospital years ago, in charge of a large ward of women, I habitually used a solution labelled "Morphine" which contained none of that alkaloid, but just enough quinine to make it conform in taste to the knowledge of the habitués of the institution, and in three cases out of five it aided in bringing comfort and rest, as well as did the genuine morphine solution. Some time ago I gave to a patient, with very minute and emphatic instructions as to the method of use, a prescription for pills of bread. Several months after she came back to me and said, "Doc-

tor, why did you not give me that prescription sooner? It is the only thing that has reached my case, and I have had that prescription filled at the apothecary's for a number of my friends with extraordinary results."

The physician who fails to avail himself in disease of the "expectant attention" drops one of the most important articles out of his list of medicinal agencies. The history of quackery is full of lessons as to the truth of this. The innumerable certificates of the value of infinitesimal doses, and the successes of "Christian Science" and the "Faith Cure" in recent times, as well as the great relief afforded our grandfathers and grandmothers by Perkins's tractors, and the reputations of numerous charlatans,—all bear witness to the efficacy of faith as an agent of healing. Some years since there was in my employ a boy who had contracted malarial chills of a most obstinate variety, for which I myself had treated him through some months with great care, without preventing the occasional return of the paroxysms. Happening to have a medical friend well provided by nature with bald head, long beard, and solemn aspect, I had the boy taken by him into a partly darkened room and addressed in a very impressive manner, with the final statement that he would only have one chill more. The result coincided with the prophecy. After having been at Luys's Clinic in Paris, and watched the results obtained by hypnotism, I myself firmly believe that these results are the outcome of the effects of emotion upon the organism. The cures have been usually alleged by the believers in hypnotism as a therapeutic measure to be due to the suggestions made to the patients while in the hypnotic condition, and it has been asserted that these cures are proof that suggestions have an influence upon the nervous system without acting through the consciousness of the patient. I believe that the patient often does not remember the suggestions when he recovers consciousness, but it must be borne in mind that the whole atmosphere of the place in which Professor Luys receives his patients is heavy with faith, and the scene of the daily clinic itself most weird and impressive—one, two, three learned doctors, with grave countenance and studied mien, going about among a number of individuals, commanding them at will, putting them asleep one after another, until the room is full of quiet automatons, who marshal themselves at the will of the physicians. At the clinic I noticed two things: first, that the patients were those whose nervous systems would naturally be expected to be influenced by "expectant attention;" second, that not rarely the assistants, in the hurry of the morning, made very slight suggestions and perhaps failed to suggest at all. After my return home, in my own wards at the University Hospital, by hypnotism without suggestions I obtained cures of palsies of standing, of tremors resembling those of paralysis

agitans, and of other cases, some exactly simulating one or more of the most famous of Luys's cures. It appears to me that in the therapeutic history of hypnotism we have simply another example of the great influence of mind over matter. Tremors cease, convulsions fail to recur, and motion returns to paralyzed limbs, simply because the difficulty was always nothing more than a functional nervous disorder, which can be set aside by a nervous impression more powerful and profound than that which first produced the symptoms.

Temperament and Idiosyncrasy.—Temperaments may be defined to be peculiarities which characterize classes of individuals, whilst idiosyncrasies are peculiarities which belong to separate individuals. The word "temperament" is sometimes used by writers as synonymous with "diathesis," and yet the ideas expressed by the two terms are essentially different. Temperaments are natural conditions of the body which cannot be separated from any conception of the human race. Diathesis is defined by Billings to be "a state or condition of the body which predisposes to certain forms of disease." It is, in other words, a morbid tendency, a bodily peculiarity, which has been acquired by the individual himself or by the stock from which he has sprung, and which does not form a portion of an abstract conception of humanity.

The most usually accepted classification of temperament is into the nervous, the sanguine, the bilious, and the phlegmatic: but Dr. Thomas Laycock, who has written quite extensively on the subject, makes six divisions, which may be epitomized as follows:

1. Predominant innervation, or nervous temperament;
2. Predominant sanguinification, or sanguine temperament;
3. Predominant carbon excretion, or bilious temperament, associated with muscular activity and good innervation;
4. Tendency to fat-formation or deposit, with good muscular activity and low innervation and sanguinification; phlegmatic temperament.
5. Comparatively deficient innervation, sanguinification, muscular and vascular activity; lymphatic temperament;
6. Comparatively defective innervation, sanguinification, and vascular activity, with tendency to carbon deposit; melancholic temperament.

The American race is being formed by the fusion of individual elements of different origin, and it is rare to find an individual who closely approximates any typical definitions of the temperament. I do not think that in this country the question of temperament enters largely into the treatment of disease, unless it be in so far that there is a tendency to an excessive development of nervous sensitiveness, which is apt to be accompanied by excessive susceptibility to the action of remedies. In such individuals success is often obtained only by the use of doses which in phlegmatic subjects would produce no effect whatever.

The most important diatheses are the strumous and the gouty. When present they greatly modify the manifestations of acute and chronic diseases, and require careful and special treatment; but a discussion of this subject does not belong to a general introduction, and requires careful treatment in a separate chapter.

The physician who is desirous of success in his profession must always remember that he is treating not so much a disease as an individual, and that it is essential carefully to consult the peculiar tendencies, moral, mental, and physical, of the man or woman who is the patient. Some of these individual peculiarities occur so frequently that they may, to some extent, be foreseen. Thus, it will be found that in a large proportion of nervous, delicate, excitable women opiates produce violent nausea and after-depression, failing to act happily. For the greater part, however, idiosyncrasies are the peculiar properties of the individual, and cannot be known, even to the person most interested, except as the result of experience. They are often entirely unaccountable and beyond conception in their strangeness. Thus, a very active and renowned physician in Philadelphia is so susceptible to the odor of the hyacinth-plant that a single sprig of the flower in the room will produce in him nausea, followed by vomiting and collapse. A near relative of the writer was so susceptible to butter that the smallest portion of it, even cutting the bread with a knife that had been used to cut butter, would produce syncope. A physician, now dead, formerly a resident in the Pennsylvania Hospital, found that whenever he went on duty in the hospital he would become in a few days covered with boils, and so ill that he would be forced to go to bed. After this had been repeated a number of times it was discovered that it happened only when he was on duty in the surgical ward, but not until after he had resigned from the hospital was it made out that the attacks were due to the effects on his skin of the vapors of the turpentine used at that time to clean the marks of sticking-plaster off of the patients. Again, I have known of cases in which a few grains of ipecacuanha diffused through the air would produce violent bronchial irritation. Every student of asthma is aware that there are persons in whom asthmatic attacks are precipitated by some presence, otherwise intangible, that hangs about the air of certain rooms. I have seen a few grains of quinine repeatedly produce complete blindness in the same individual, and in other cases cause severe skin irritation. Another idiosyncrasy under my personal notice is that a few mouthfuls of lobster, boiled or broiled, will invariably produce an extraordinary and furious attack of herpes. These peculiarities are sometimes hereditary, as I know of a family in which eating an egg has in successive generations habitually caused in a few minutes violent headache, accompanied with fever, and after a short time an eruption upon the surface of the body.

Much space might be occupied with a description of the physical vagaries of humanity in their relations to drugs and to foods. The old saw, "One man's meat is another man's poison," expresses the whole matter. On the other hand, every physician is familiar with the fact that nothing is more common than for persons to imagine that they cannot take this or that remedy without the production of disagreeable and dangerous effects. Whilst, therefore, it is the duty of the doctor always, when called to a patient whose peculiarities are to him unknown, to inquire carefully for idiosyncrasies, care must be exercised in the proper weighing and appreciation of the statements made. I think that physicians more frequently err in refusing credence than in accepting too much.

Disease.—No circumstances affect the influence of medicine more than the morbid states of the individual that is being treated. For the purpose of discussion these morbid states can, at present, best be considered as follows: first, those for the remedying of which the remedy is given; second, those which are not being treated, but which at the same time may influence the action of the drug used.

It is evident that a direct antagonism often exists, if not between the medicine and the disease itself, at least between the drug and the cause of the disorder. A case of poisoning as the simplest example may be taken. We are so accustomed to considering poisonings as apart from disease that the illustration may not at first appear apt, but, after all, most acute disorders are nothing more or less than poisonings. There is no innate difference between an attack which is brought on by a mineral, vegetable, or animal poison that we call a drug because we use it in small dose for medical purposes, and an attack which is produced by a poison which we call a "natural cause" simply because we have not isolated the poison and employed it as the embodiment of a force capable, when properly used, of relieving human suffering. It is evident that if the system be under the influence of a drug A, which has produced a great depression of functional activity, a much larger amount of the drug B, which increases functional activity, must be used to produce a visible effect than would be required if the system were in normal condition. If a platform held up by a spiral spring be loaded with heavy weights, much greater force will be required to elevate it than would be otherwise required.

These remarks apply not only to the remedial, but to the physiological, action of drugs. In the man under the depressing influence of snake-poison, or of typhoid-fever poison, or of the ptomaïnes and other products which have been produced in his own system by the diphtheritic coccus,—in such a man doses of alcohol that in health would cause drunkenness produce no acceleration of the pulse, no mental confusion, no disorder of locomotion, and, what is most strange and almost unac-

countable, apparently are not eliminated. The power of the system under these circumstances of destroying the alcohol seems to be greatly increased beyond its normal limit, so that no odor appears on the breath, though the patient may be taking a pint of whiskey every twenty-four hours.

The resisting influence of one poison to that of another is felt both ways; the heart, that is stimulated by large doses of digitalis, responds less rapidly to the influence of aconite, precisely as one which is under the influence of aconite requires, in order for any appreciable effect to be produced, much more than the normal dose of digitalis. The mutual reaction of counteracting forces is easily understood, and would seem *a priori* to be a necessity inside of the human system as well as outside of it. It is not, however, so easily comprehended why conditions of body or of organs influence as much as they do the effects of remedies. It is, however, a thoroughly established clinical fact that the states of the body and of the tissues markedly affect the size of the doses which it is proper to use. In many cases of disease it is very difficult to decide how far the altered relations of medicine may be due to the direct counteracting influences of a poison, and how much to the conditions of the bodily forces. The cases of disease in which we have remedies that may be considered specific in character belong to this category. It is well established that malaria protects the general system from the action of quinine; twenty grains of the alkaloid will profoundly affect most normal individuals, whilst in malarial affections thirty, forty, and even fifty grains may be given without causing evidences of their physiological action. This may be due to the condition of the nervous system produced by malaria, but I think most physicians would be inclined to suppose that it is the result of the quinine being resisted by the malarial poison itself or by some of its products in the human body.

On the other hand, the syphilitic person withstands doses of mercury or of iodides that ordinarily cannot be given. This, I think, would generally be considered to be due, not to the presence in the body of any primary or secondary poison, but to the altered nutritive state of the tissues. That bodily conditions do affect the drug relations of the human organism is certain. In pure and simple exhaustion, whether it has been produced by disease, by over-exertion, or by long-continued depressing influences, or whether it is secondary to the over-use of a stimulant, much larger amounts of stimulants are required to make an impression than in health. In delirium tremens, in insomnia from excessive brain excitement, doses of narcotics which in health would almost paralyze fail to produce sleep. The heart that is weakened by structural changes responds but slowly to the largest doses of digitalis; the kidney that is fatty or atrophied is sluggish in all its reactions; the stomach whose mucous membrane is inflamed and whose blood-vessels

are dilated by habitual alcoholic excess scarcely perceives the irritating influences of the largest doses of capsicum.

From considerations such as these certain practical deductions naturally result. In most cases of general disorder the drug-forces may work in a manner that is antagonistic to the influence of the poison that is already present, or to the condition that is already present in the system. Usually, the indication is for the employment of those drug-forces which are antagonistic to the poison or condition. Remedies of this character are usually well borne, as it is technically expressed—*i. e.* they may be given and may do good in doses which are much larger than those of the textbooks. At the same time, it must never be forgotten that a fatal effect may be produced by over-dosing in these cases without the most prominent of the symptoms of the disorder being overcome. Especially is this true because most drugs have more than one action. As an example, take delirium tremens: if the practitioner insists at all hazards upon enforcing sleep by opium, he may do the patient fatal injury; in a case of tetanus convulsions can always be suspended summarily by the use of anæsthetics, chloral, and similar drugs, but the suspension of the convulsion may be accomplished at the cost of the patient's life. Sometimes, moreover, the drug which has failed to produce any symptoms of its action for a long time seems suddenly to overcome the antagonistic force and at once to act upon the system.

A curious and almost inexplicable illustration of the fact that a remedy may be acting when apparently it is exerting no influence sometimes occurs in the use of mustard plasters in conditions of excessive irritation. Thus, I have repeatedly known a person suffering from some violent internal irritation, with excessive pain, to allow a strong mustard plaster to stay on the skin perhaps for several hours without there being produced at the time any smarting, redness, or appreciable effect on the surface, although on the following day there was developed violent inflammation, with vesication or even sloughing of the skin, confined exactly to the site of the mustard plaster, proving that a very active effect had been produced by the plaster, although such effect was at first completely masked by the internal irritation. The mustard plaster counter-irritates against an internal irritation, but the internal irritation also counter-irritates against the mustard plaster. What takes place upon the surface of the body, openly and visibly to our senses, may also occur internally in a hidden manner. The utmost caution should therefore be practised in using drugs against internal poisons or diseases in such doses as would, in a healthy individual, actually endanger life; only under peculiar circumstances are these doses justifiable.

Diseases which affect the influence of drugs not used against them

are commonly local affections, which are of importance solely as offering some objection to employment of the otherwise indicated drugs. My experience has been that these side issues, so to speak, are frequently lost sight of by practising physicians, with great resulting injury to the patients, so that I think that it is not a waste of space to make detailed mention of some of the more frequent of them. Irritability and inflammation of the mucous membranes of the stomach and bowels contraindicate tonics, since simple bitters, quinine, nux vomica, and most preparations of iron are more or less irritating. Very many cases of general debility depend upon chronic irritation of the stomach or intestines. A little habitual diarrhœa, which consists simply of one loose passage a day, is apt to be overlooked, and the resulting debility is improperly treated with quinine and iron and similar remedies.

Of all ordinary remedies quinine is the one most frequently contraindicated by local disease at a time when it is indicated by the general condition. It is powerfully irritant to the gastro-intestinal tract: it congests or increases an already existing congestion of the middle ear, and is undoubtedly, when used too freely, capable itself of causing middle-ear deafness. It should never be given when there is a tendency to such disorder unless actually necessary for the saving of life.

The irritating influence of drugs is felt not only at their point of entrance, but also at their point of exit; hence, most irritants are contraindicated by the existence of irritation or tendency to irritation in the urinary organs. Quinine, when given freely, very greatly irritates the mucous membrane of the bladder, and for this reason in old persons who are prone to bladder irritability it must always be used with caution. Not long since I was paying a visit to a well-known surgeon, who was recovering from an attack of prostatic abscess under the care of an equally renowned surgeon. Convalescence was absolutely in abeyance, owing to a violent pain in the neck of the bladder which came on every afternoon. On inquiry I found that quinine was being given freely as a tonic, and when I told my surgical friends that I believed it was the cause of the pain, there was a good deal of astonishment; nevertheless, when the quinine was stopped the pain rapidly subsided.

The unreliability of empirical therapeutics, as well as the credulity of physicians in regard to absurd assertions, is seen in the enormous use which has been made of chlorate of potassium in diphtheria. The administration of the chlorate seems to have been based on the theory that it would yield nascent oxygen in the system and purify the blood. Chlorate of potassium is decomposed, however, only at a white heat. When ingested it is eliminated, unchanged, as the chlorate, and there is not the slightest reason for supposing that it is decomposed in the human system or that it has any influence in

diphtheria, save only as it exerts a slight local influence upon diseased mucous membranes. On the other hand, one of the chief dangers of diphtheria is nephritis, and chlorate of potassium is a violent irritant to the kidneys; yet it has been given almost universally in enormous doses in diphtheria. I have no doubt that a notable percentage of the deaths set down to diphtheria have been due in fact to the chlorate of potassium.

On the Combining of Drugs.

In prescribing medicines the physician ought always to bear in mind that the forces which he employs are capable of acting for evil as well as for good, and that in consequence drugs are not to be administered without good reason for their use. Such a principle as this is directly opposed to the habit of polypharmacy—*i. e.* to the custom of combining a large number of drugs into one avalanche of unknown and unknowable power. When a dozen active and perhaps more or less antagonistic agencies are thrown together into one confused mass, who can tell what will be the resultant angle of forces? If simplicity be not an unerring sign of the master in medicine, multiplicity of combination is without doubt the mark of the bungler and of the ignoramus. It is usually better to prescribe powerful remedies singly, but when circumstances seem to demand a combination of remedies such combination should only be made in accordance with definite rules or principles.

A very important consideration in regard to the combining of drugs, one which is not rarely lost sight of, is that even when drugs are to be exhibited together it is frequently better to keep them separate and uncombined, because the exigencies of the case may well require variations of the dose of the one without corresponding increase or decrease of the dose of the other. This is especially true when one medicine is comparatively inert and the other very active, or when it is desired to push one or more of the remedies to the full physiological limit. Even such learned and practical men as the framers of the U. S. Pharmacopœia have lost sight of this principle in various cases. According to my thinking, it is hard to conceive of a greater pharmaceutical abomination than the officinal citrate of iron and strychnine, which is made upon the principle of hitching together an ox and a race-horse. The iron preparations are of slow action, and in most cases it makes very little difference whether more or less than the average dose of them is given. Strychnine is a powerful and rapid remedy, whose dose should always be carefully graduated to the individual case of disease. The officinal preparation has no advantages whatever, and has the great disadvantage of leading the doctor to prescribe in a routine way without attempting to adapt doses to the needs of the indi-

vidual patient. Even such preparations as the iodide of iron are somewhat open to this objection. Very few physicians have any idea how much iodine the patient is getting when he is taking twenty drops of the syrup of the iodide of iron; and if the two remedies are to be given to the child, in my opinion it is generally better to give iron as iron and iodine as iodine.

The most important and practical of the rules governing the combining of remedies are as follows: First, *medicines are combined together to meet several coexisting indications.* The purpose expressed in this law is the one which most frequently leads to the use of the multiplicity of drugs, so that the practitioner should always remember the importance of not being led away by minor pointings of nature. An illustration of the application of the present law is in a prescription for a cough mixture in the first stages of a bronchial inflammation. In an ordinary case the indications would be to bring about secretion; hence the following prescription, in which two substances, the citrate of potassium and the syrup of ipecacuanha, are used to fulfil the indications, whilst the syrup and the lemon-juice are added to make the mixture less nauseous to the stomach:

℞. Potassii citratis, ʒj;
Succi limonis, fʒiss;
Syr. ipecacuanhæ, fʒss;
Syrupi, q. s. ad fʒiij.

S. Dessertspoonful every two hours.

Supposing, however, there should be in any case an excessive nervous cough, morphine or some other narcotic might advantageously be added to the foregoing prescription, or if there were considerable arterial excitement the indication would be for the addition of tartar emetic or a similar remedy.

Second, *substances are combined for purposes of joint action or to modify the influence one of the other.* The application of this law is best illustrated by a purgative combination. Supposing a substance, A, acts upon the mucous membrane of the large intestine, while substance B influences especially the smaller intestine, and substance C affects the muscular coat. It is evident that when a thorough purgative action is desired the combination of all these three will act better than either remedy alone. It is for this reason that such polypharmaceutical preparations as the compound cathartic pill especially prevail among purgative remedies. Then, again, it has been found that certain narcotic substances lessen the irritation produced by the cathartic; hence narcotics are often put into purgative combinations to modify the action of the purgatives. Laudanum is habitually exhibited with castor oil, and the extract of belladonna added to the purgative pill.

Third, a very important law of combination is that which I venture to call *the law of crossed action*. Suppose, for instance, that a certain remedy, A, influences the system in such a way that its action can be represented by a horizontal line which runs through the point X, whilst the action of B is properly represented by a vertical line which also passes through the point X. It is evident that the point X will receive an impression proportionately much stronger than that of any other point of the body. A practical illustration of the value of this law is found in the great utility as a hypnotic of a mixture of chloral and morphine. Chloral acts upon the cerebral cortex as a somnifacient, and at the same time affects the heart and the spinal cord. Morphine acts upon the cerebral cortex as a somnifacient, but has little or no influence upon the spinal cord or the heart, although it is prone to disarrange digestion. A mixture of chloral and morphine, therefore, whilst powerfully acting upon the cerebral cortex as a hypnotic, influences the heart and spinal cord much less forcibly than would a corresponding dose of chloral, and disarranges digestion much less severely than would the corresponding dose of opium.

In the process of combining drugs the physician practises the art of prescription-writing, but as Professor Remington is to discuss this art in detail, my remarks upon it shall be restricted to a few considerations which might readily be everlooked by one who looks at the subject solely from a pharmaceutical point of view.

Almost every prescription consists of two parts—the vehicle and the remedy or remedies. In the case of mixtures or solutions it is usual for the physician to state what vehicle shall be employed. When a solid preparation is to be made, however, the choice of the excipient should be left to the apothecary, who will be much more apt than the physician to know the exact physical and chemical qualities required, as well as the necessary quantities.

Almost as great a reproach to the doctor as polypharmaceutical prescriptions is the habit of changing medicine unnecessarily and of prescribing it in too large quantities. Time is usually required for any effect to be produced by remedies, and a great array of unused bottles is, to many sick persons and their friends, a great aggravation. Care should be taken to adapt the number of doses in a prescription to the probable length of time during which it shall be used; not to prescribe fifty pills or a pint of mixture when ten pills or a few ounces are all that will be required.

Most medicines are nauseous. Among certain semi-barbarous tribes and peoples, including Irishmen and Irishwomen of the peasant class, the disagreeableness of a drug is intimately associated with the expectation of relief; but in this present age of over-comfort and luxury the physician who hopes to be successful amongst the better classes of society

will carefully study the art of rendering medicine as little unpleasant as possible. In doing this certain general rules of practice may be followed out. A remedy should not be given in a liquid form when it can as well be administered in solid. When the solid form is chosen it should be one that is readily soluble in the stomach, and at the same time insoluble in the mouth, as far as may be. The pill is better than the powder, but the gelatin capsule is better than the pill, because it is tasteless and at the same time rapidly disappears in the stomach. Sugar-coated pills were in their time an admirable product of the pharmaceutical art; at present they are inferior. Gelatin-coated pills are more readily soluble and as readily taken. A favorite preparation with many practitioners is the compressed pill, and when properly made of a substance fitted for this method of exhibition it is very commendable, on account of the smallness of its size in proportion to the dose which it contains. On the other hand, as it is often put upon the market composed of entirely insoluble substances, it may be a delusion and a snare. The basis of it should always be soluble. A compressed pill of quinine should be made of the bisulphate, and not of the sulphate. A compressed pill of a substance as insoluble as sulphonal should never be made at all. The popularity of the compressed pill of sulphonal I think is one reason why this drug has so frequently failed in practical medicine. Probably any one who will watch the passages from the bowels of a patient taking these pills will find the pills, as I have done, discharged from the anus almost as fresh and bright as when taken into the mouth. If, instead of being made into a solid mass, the powder of suphonal, quinine, or other insoluble remedy be pressed not too tightly into a capsule, the best method of administration is obtained. Volatile oils and similar liquids, whose dose is small, are usually, when disagreeable in taste, best given in the capsules; especially is the so-called "soft" capsule adapted for the exhibition of liquids. Most persons can readily swallow a soft capsule containing one or two drachms. The use of the pill or capsule with very irritating substances requires some caution, lest the concentrated irritant should come in contact with the mucous membrane of the stomach. Usually this difficulty can be well met by administering the drug only when the stomach is full or by taking liquid with the dose.

PRESCRIPTION-WRITING AND THE COMBINATION OF DRUGS.

By JOSEPH P. REMINGTON, Ph. M.

Prescriptions.

The prescription[1] is the written direction of a physician indicating the remedy for a disease. All prescriptions may be classified under the two divisions—"official," or permanent, and "magistral," or extemporaneous.

"Official" prescriptions include all formulæ that are issued under official authority, as, for example, those of the various pharmacopœias, which are official in the various countries where the several pharmacopœias are issued. In the United States, however, those only are considered official that are contained in the "United States Pharmacopœia," which is issued by the authority of the Pharmacopœial Convention, a body convened especially for the purpose; or semi-official if by the "National Formulary," which is published under the authority of the American Pharmaceutical Association. Prescriptions for official formulæ can nearly always be dispensed by the pharmacist without delay, as official prescriptions are made in advance and are kept on his shelves ready for use.

"Magistral" prescriptions include such as are made up extemporaneously by the pharmacist according to special directions, and embrace those ordinarily prescribed by the physician: these are "unofficial," and might properly be called officinal, but this term has been used so long in the United States as meaning official that its use in this connection would no doubt lead to confusion.

A further great division of these two classes separates them into such as are used internally and such as are used for external application, and these are again subdivided into "Liquids" and "Solids," which are still further separated into groups or classes based upon similarity of composition or mode of preparation.

In writing prescriptions there are so many points to be considered that it requires rare knowledge and judgment to avoid falling into some mistake or inaccuracy, and prescriptions that can be considered as models in all respects are not frequently met with. They should always be written in a clear, legible hand on clean white paper, and with pen

[1] *Præscriptio—præ*, "before," and *scribo*, "I write."

and ink; if written with lead-pencil (which many physicians are in the habit of using), the characters are very apt to become blurred and indistinct before reaching the pharmacist.

Latin names should be used to designate the ingredients of the prescription, as being more definite and precise than English names. Latin being a dead language, its rules are fixed and established, and not liable to changes of fashion or fancy, as are living languages. It has been chosen as the language of science in all countries, and is the great storehouse from which the scientific world has ever been accustomed to draw its technical phraseology. The chief merit of Latin is its precision, and in no science is precision more important or necessary than in medicine. The Latin name applied to a drug is specific and has but one meaning, while in English the same name is often applied to many drugs; as, for example, "Indian hemp" is applied to Cannabis Indica, to Asclepias incarnata, and also to Apocynum cannabinum, drugs having entirely different properties. "Hellebore" is applied to Helleborus Americana, to Helleborus niger, to Veratrum album, to Veratrum viride, and to Dracontium fœtidum. "Snake-root" is applied to Aristolochia serpentaria, to Asarum Canadense, to Cimicifuga racemosa, to Eryngium aquaticum, to Eupatorium aromaticum, to Liatris spicata, to Macrotis, to Polygala senega.

On the other hand, many names are frequently applied to one drug; thus, "Gaultheria procumbens" is called checker-berry, box-berry, deer-berry, grouse-berry, spice-berry, tea-berry, partridge-berry, berried tea, gaultheria, trailing gaultheria, ground ivy, spicy wintergreen, and mountain tea.

It is frequently desirable that the patient should not be advised of the name of the medicine prescribed, and this object may generally be attained by the use of Latin.

When an unusually large dose of medicine is prescribed, it should be marked in some special way to show that such a dose is not a mistake, but is intended; this may be done by a note at the bottom of the prescription: "Correct dose" or "Intentional;" or by writing out the specific quantities in letters as well as in symbols or figures; thus, "℥j (one drachm), gr. xxv (twenty-five grains);" an unusual dose is sometimes emphasized by underscoring or by an exclamation-mark, thus (!). When such precaution is not used a careful pharmacist may refuse to put up the prescription before consulting the physician, and thus valuable time may be lost.

Abbreviations of names are allowable only where there can be no doubt of their meaning, and such as may possibly admit of more than one meaning should be studiously avoided. The name of each ingredient and the quantity or amount of it required should always be placed on the same line.

Prescriptions should never be written partly in Latin and partly in English; such writing is evidence of either carelessness or ignorance. It is customary with some physicians to commence their prescriptions by writing down the names of the medicines which they intend to give, and afterward putting in the quantity desired of each article; objections to this plan are the liability or danger of transposing the quantities, or from oversight omitting to put down the quantity of one or more of the ingredients.

The physician should always sign his name to a prescription: the use of printed forms or prescription-blanks is very common, and very useful as giving the name, residence, and office-hours of the prescriber. If such forms are not used, it becomes still more important and desirable that the physician should sign his name to the prescription, so that in case of doubt or difficulty, either on account of the illegibility or any actual or supposed mistake, the pharmacist could communicate with the physician without the necessity of going to the patient and without the knowledge of the latter.

The name of the person for whom the prescription is intended should be written upon it, especially where there are two or more patients in the same house; as also the date when written. These precautions will frequently prevent mistakes which might otherwise occur; the date makes it convenient for reference, and may become of great importance from a medico-legal point of view.

Although there is no inflexible rule by which the order of the ingredients in a prescription may be determined, yet by following certain directions their best arrangement may be secured. A model prescription consists of some or all of the following parts:

1st. The superscription or heading;

2d. The inscription or enumeration of the ingredients, with their quantities;

3d. The subscription, or directions to the pharmacist;

4th. The signa, or direction for the patient as to the use of the medicine.

In addition to these parts should be added the name of the patient, the date when written, and the name of the physician, together with his address.

The superscription in Latin prescriptions consists of the letter ℞, the first letter of the word *Recipe* (take), being the imperative of the verb *recipio*. The most important part of the prescription is the inscription, the part requiring the knowledge and judgment of the physician in selecting the various remedies to be employed and apportioning their quantities. The principal active ingredient of a prescription is called the "basis;" this may be prescribed alone or in combination with other remedies. The next important ingredient in a mixture is the "vehicle," or, as sometimes called, the "diluent," which

furnishes the means of dividing and giving the proper dose of the medicine. If another medicine be added to assist the basis, it is called the "adjuvant," while articles intended to modify or qualify the action of the active ingredients are called "correctives."

The subscription is the direction to the pharmacist for compounding the prescription. Formerly it was the custom of the physician to give full directions for mixing the ingredients of a prescription and for compounding generally; these points are now usually left to the skill and judgment of the pharmacist, who is presumed to know how certain ingredients should be mixed, and short directions are generally given, such as misce (mix), solve (dissolve), fiat solutio, mistura, or pilula, as the case may be, leaving the mode of mixture and choice of excipient entirely to the pharmacist.

The signa, or direction intended for the patient, usually abbreviated "Sig.," or sometimes simply "S.," should always be written in English, distinctly and without abbreviation; written in Latin, it seems pedantic; besides which, there is liability to error in having the pharmacist translate it for the patient, who will certainly require it to be in English.

The following, illustrative of a modern model prescription, is given with a view of showing all of the parts:

Sept. 10, 1891.

For Mrs. E. M. T——.

Recipe (*Take*) — *Superscription.*

(*Basis.*) Extracti rhamni purshiani fluidi, fluidunciam;
Of fluid extract of cascara sagrada, 1 fluidounce;

(*Adjuvant.*) Extracti sennæ fluidi, semifluidunciam;
Of fluid extract of senna, ½ fluidounce;

Extracti glycyrrhizæ fluidi, fluidrachmas duas; — *Inscription.*
Of fluid extract of liquorice, 2 fluidrachms;

(*Corrective.*) Elixir aromatici, fluiduncias tres;
Of aromatic elixir, 3 fluidounces;

(*Vehicle.*) Syrupi, quantum sufficit ut fiant fluidunciæ sex;
Of syrup a sufficient quantity to make 6 fluidounces;

Misce, et filtra si opus sit. — *Subscription.*
Mix, and filter if necessary.

Signa (*mark or label*), *a dessert-spoonful at night.* — *Signa.*

George B. Wood.

Abbreviated Form.

Sept. 10, 1891.

For Mrs. E. M. T——.

℞. *Ext. rham. pursh. fld.*, ℥j;
Ext. sennæ fld., ℥ss;
Ext. glycyrrh. fld., ℥ij;
Elix. aromat., ℥iij;
Syrup. q. s. ft. ℥vj.
M. et filt. si op. sit.
Sig. A dessert-spoonful at night. *G. B. W.*

Weights and Measures.—The ordinary weights and measures used in pharmacy and medicine are relics that have been bequeathed from a

past age, in which lack of system and uniformity are painfully apparent; they are as follows:

Apothecaries' Weight (also called Troy Weight).

Libra, Pound.		*Uncia,* Troy Ounce.		*Drachma,* Drachm.		*Scrupulus,* Scruple.		*Granum,* Grain.
℔ 1	=	12	=	96	=	288	=	5760
		℥ 1	=	8	=	24	=	480
				ʒ 1	=	3	=	60
						℈ 1	=	gr. 20

The British Pharmacopœia has adopted avoirdupois weight, which is also in general use in the United States for commercial purposes.

Avoirdupois Weight.

Pound.		Ounces.		Grains.
℔ 1	=	16	=	7000
		oz. 1	=	437.5

It will be observed that the troy ounce contains 42½ grains *more* than the avoirdupois ounce, whilst the troy pound contains 1240 grains *less* than the avoirdupois pound. Fortunately, one unit common to troy, apothecaries', and avoirdupois weight has been saved—namely, *the grain.* The abbreviations of the denominations of apothecaries' weight are represented by the signs ℥, ounce; ʒ, drachm; ℈, scruple; and gr., grain: these have long been in use, but are very likely to be mistaken for one another in rapid or careless writing. The abbreviations or signs for avoirdupois weight differ from those of troy weight, and care should be used not to confound them; they are ℔., pound; oz., ounce; gr., grain.

MEASURES.

Apothecaries' or Wine Measure, U. S.

Congius, Gallon.		*Octarius,* Pint.		*Fluiduncia,* Fluidounce.		*Fluidrachma,* Fluidrachm.		*Minimum,* Minim.
Cong. 1	=	8	=	128	=	1024	=	61440
		O 1	=	16	=	128	=	7680
				f℥ 1	=	8	=	480
						f ʒ 1	=	♏ 60

Imperial Measure, Br.

(Adopted by the British Pharmacopœia.)

Congius, Gallon.		*Octarius,* Pint.		*Fluiduncia,* Fluidounce.		*Fluidrachma,* Fluidrachm.		*Minimum,* Minim.
C. 1	=	8	=	160	=	1280	=	76800
		O 1	=	20	=	160	=	9600
				fl. oz. 1	=	8	=	480
						fl. dr. 1	=	min. 60

When the subject of the weights and measures in ordinary use is studied, the want of simplicity and close relation is clearly apparent. The pint of distilled water at 15.6° C. (60° F.) weighs 7291.2 grains, the fluidounce 455.7 grains, and we have thus three ounces in use of

different values: troy ounce, 480 grains; avoirdupois ounce, 437.5 grains; and fluidounce, 455.7 grains.

The Imperial measure differs from our wine measure principally in having twenty fluidounces in the pint instead of sixteen: a convenient relation exists, however, between measure and weight in the *Imperial gallon, which contains ten avoirdupois pounds of water at* 15.6° C. (60° F.).

The Imperial fluidounce contains the same number of grains as the avoirdupois ounce (437.5), which is 18.2 grains less than that of the U. S. fluidounce of water at the same temperature (455.7). Although this difference may be considered trifling in one fluidounce, it is not so when multiplied by four or eight; and this is one serious objection to the use of the English graduated measures in the United States, because they indicate Imperial fluidounces instead of U. S. fluidounces.

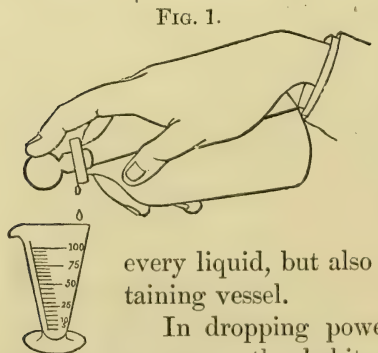
Much discussion has arisen respecting the comparative accuracy of preparing prescriptions by weighing or measuring. In the hands of a careful pharmacist either method will be found satisfactory, while with a careless one neither will be accurate. When, however, the difference in dosage, resulting from difference in size of spoons with which medicines are usually administered, is considered, the difference between the two methods will usually be insignificant. As liquid medicines are always given by measure, it would seem to be most rational to *prescribe liquids by measure*, and thus avoid the necessity for calculating the difference in dose due to the difference between weight and volume. In English-speaking countries the custom is firmly established of *weighing solids* and *measuring liquids*.

For convenience the following domestic measures are commonly used:

The tea-cup	(poculum)	equal to	f℥iv
wine-glass	(cyathus vinarius)	"	f℥ij
table-spoon	(cochlear magnum)	"	fʒiv
dessert-spoon	(cochlear medium)	"	fʒij
tea-spoon	(cochlear parvum)	"	fʒj.

All of the above measures vary very considerably in value, and therefore where accurate dosage is important the use of graduated glass measures or medicine-glasses, which can now be readily obtained, should be insisted on. The drop is usually considered to be equivalent to the minim; it is nearly so in the case of water, but varies not only with every liquid, but also with the size and shape of the containing vessel.

Fig. 1.



Dropping from Shop-bottle.

In dropping powerful liquids or when great care is necessary, the habit of holding the bottle as shown in Fig. 1 should be cultivated.

The Metric System in Prescriptions.—In view of the adoption of the metric system by the Pharmacopœia Convention of 1890, it is necessary that every pharmacist, and most desirable that every physician, should understand how to read and write prescriptions in this method. In order to avoid mistakes, a correct knowledge of the terms employed, together with a just appreciation of their values, is essential. The terms usually employed should be so thoroughly understood that when met with definite ideas of weight, capacity, or length, as the case may be, are immediately conveyed to the mind, without requiring a comparison with, or conversion into, ordinary or accustomed measures.

In Germany and some other continental countries prescriptions are prepared almost exclusively by weight, liquids as well as solids being thus dispensed, and quantities are all expressed in grammes. In this country, however, it is the custom to weigh solids and to measure liquids, with the exception of a few oily or viscid liquids, in which special cases weighing becomes more convenient than measuring.

The quantities employed in prescriptions are usually designated by multiples or subdivisions of the gramme for solids and of the cubic centimetre for liquids. Gm. is the abbreviation ordinarily used for the gramme, and c.c. that for the cubic centimetre, and they are always written after the quantities, thus differing from the ordinary method of writing prescriptions; moreover, the quantities are expressed in Arabic numerals, and not in Roman figures, again differing from the usual style.

The gramme is equivalent to about 15.5 grains (more exactly 15.432 grains), and the cubic centimetre is the measure of a gramme of distilled water; in order more thoroughly to show the relation existing between these, a cubic centimetre is sometimes called a fluigramme; this is equivalent to about 16 minims (more exactly 16.23 minims), and consequently 1 grain is equivalent to about 0.06 c.c. (6 hundredths of a cubic centimetre). The gramme is divided into 10 decigrammes, or 100 centigrammes, or 1000 milligrammes.

The term "decigramme" is rarely used, quantities being usually expressed in grammes and centigrammes; just as in our decimal currency we usually reckon by dollars and cents, seldom using dimes. Where fractions of a centigramme occur they are usually designated as so many milligrammes.

All the measures in this system are derived from the metre, hence it is called the Metric System; it is also called the Decimal System, because all the measures bear decimal relations to each other. The unit of length is the "metre," which is the forty-millionth part of the circumference of the earth around the poles: from this are derived all the other measures, including those of length, capacity, weight, and

area. The unit of capacity is the "litre," which is the measure of a portion of water that would just fill a hollow cube each side of which measures one-tenth of a metre. The unit of weight is the "gramme," which is the weight of a portion of water that would just fill a hollow cube each side of which measures one-hundredth of a metre; hence it is sometimes called a cubic centimetre (c.c.).

From these units the other measures are derived, and are designated by prefixes: those which indicate increase are derived from the Greek, while those which indicate decrease are derived from the Latin. The Greek prefixes are deka, 10; hecto, 100; kilo, 1000; and myria, 10,000. The Latin prefixes are deci, $\frac{1}{10}$; centi, $\frac{1}{100}$; and milli, $\frac{1}{1000}$; and these prefixes to the names of the units give the following tables:

Metres.			Litres.			Grammes.		
1 millimetre, mm.	=	.001	1 millilitre, ml.	=	.001	1 milligramme, mg.	=	.001
1 centimetre, cm.	=	.01	1 centilitre, cl.	=	.01	1 centigramme, cg.	=	.01
1 decimetre, dm.	=	.1	1 decilitre, dl.	=	.1	1 decigramme, dg.	=	.1
1 metre, m.	=	**1.**	**1 litre, l.**	=	**1.**	**1 gramme, gm.**	=	**1.**
1 dekametre, dm.	=	10.	1 dekalitre, dl.	=	10.	1 dekagramme, dg.	=	10.
1 hectometre, hm.	=	100.	1 hectolitre, hl.	=	100.	1 hectogramme, hg.	=	100.
1 kilometre, km.	=	1,000.	1 kilolitre, kl.	=	1,000.	1 kilogramme, kg.	=	1,000.
1 myriametre, mm.	=	10,000.	1 myrialitre, ml.	=	10,000.	1 myriagramme, mg.	=	10,000.

It will be observed that the significant unit in all of the above tables is 1, and that the differences in value are distinguished by the position of the decimal point; hence it is all important that this point should be properly placed. In writing prescriptions the use of a line to distinguish between grammes or cubic centimetres and their fractions, similar to the line used for dividing dollars and cents in books of account, is safer and less liable to error than the use of the decimal point; it is also much more convenient than writing the denominations after each quantity, as is sometimes done. These methods are illustrated by the following prescriptions:

	Gm. & c.c.
Tinct. ferri chlor.,	2|5
Acid. acet. dilut.,	3|75
Liq. ammon. acet.,	25
Elixir aurantii,	12|5
Syrupi,	20
Aquæ, q. s. ut ft.	60

M. Ft. sec. art.

	Gm.
Tinct. ferri chlor.,	2.5
Acid. acet. dilut.,	3.75
Liq. ammon. acet.,	25.
Elixir aurantii,	12.5
Syrupi,	20
Aquæ, q. s. ut ft.	60

M. Ft. sec. art.

Tinct. ferri chlor.,	2.5 gm.
Acid. acet. dilut.,	3.75 gm.
Liq. ammon. acet.,	25 gm.
Elixir aurantii,	12.5 gm.
Syrupi,	20 gm.
Aquæ, q. s. ut ft.	60 gm.

M. Ft. sec. art.

LEEDS & WEST RIDING
MEDICO-CHIRURGICAL SOCIETY

	Gm. & c.c.		Gm.
Ext. coloc. comp.,	2	Ext. coloc. comp.,	2.
Abst. jalapæ,	1 5	Abst. jalapæ,	1.5
Hyd. chlor. mitis,	1 75	Hyd. chlor. mitis,	1.75
Pulv. gambogiæ,	4	Pulv. gambogiæ,	.4
Misce et div. in pil. No. xxv.		Misce et div. in pil. No. xxv.	

Ext. coloc. comp.,	2 gm.
Abst. jalapæ,	1.5 gm.
Hyd. chlor. mitis,	1.75 gm.
Pulv. gambogiæ,	.4 gm.
Misce et div. in pil. No. xxv.	

	Gm. & c.c.		Gm.
Pulv. cretæ,	7 5	Pulv. cretæ,	7.5
Pulv. acaciæ,	5	Pulv. acaciæ,	5
Pulv. sacchari,	12 5	Pulv. sacchari,	12.5
Aquæ cinnam.,	60	Aquæ cinnam.,	60
Aquæ, q. s. ut ft.	cxx.	Aquæ, q. s. ut ft.	cxx.

Pulv. cretæ,	7.5 gm.
Pulv. acaciæ,	5 gm.
Pulv. sacchari,	12.5 gm.
Aquæ cinnam.,	60 gm.
Aquæ, q. s. ut ft.	cxx. gm.

It will be observed that in the above prescriptions both the volumetric and gravimetric methods are used. In the gravimetric method liquids as well as solids are weighed, while in the volumetric method solids are weighed and liquids are measured; cubic centimetres (c.c.) being used in place of grammes.

Instead of learning rules for converting ordinary weights and measures into those of the metric system, it will probably be found more convenient and less difficult to memorize a few equivalent values, and from these to calculate other values.

The following equivalents will be found useful:

Lengths.

1 inch, about 25 mm. (25.3997 mm.).
1 foot, " 30 cm. (30.48006 cm.).
1 yard, " 91 cm. (91.44010 cm.).

Liquid Measures.

$\mathfrak{m}$j = about 0.06 c.c. (.0616 c.c.).
f$\bar{3}$j = " 3.75 c.c. (3.6967 c.c.).
f$\bar{3}\bar{3}$j = " 30 c.c. (29.5739 c.c.).
Oj = " 500 c.c. (0.47318 L.).
Oij = " 1000 c.c. (0.94636 L.).

Weights.

gr. j = about 0.06 gm. (64.7989 mg.).
gr. xv = " 1 gm. (97.189 cg.).
ʒj = " 4 gm. (3.8879 gm.).
℥j = " 30 gm. (31.10348 gm.).

The equivalents of French measures are as follows:

Lengths.

1 millimetre, mm. = about $\frac{1}{24}$ inch.
1 centimetre, cm. = " $1\frac{5}{12}$ inches.
1 decimetre, dm. = " 4 "
1 metre, m. = " $39\frac{3}{8}$ "

Liquid Measures.

1 millilitre, or cubic centimetre, c.c. = about ♏16.
1 centilitre, or 10 cubic centimetres = " f℥$2\frac{3}{4}$.
1 decilitre, or 100 cubic centimetres = " f℥$3\frac{3}{8}$.
1 litre, or 1000 cubic centimetres = " f℥34.

Weights.

1 milligramme, mg. = about $\frac{1}{64}$ grain.
1 centigramme, cg. = " $\frac{1}{6}$ "
1 decigramme, dg. = " $1\frac{1}{2}$ "
1 gramme, gm. = " $15\frac{1}{2}$ "

Inasmuch as many of the terms and titles used in medicine and pharmacy to-day were unknown to the ancients, new names based on Latin types have become a necessity: the following condensed glossary, however, will prove serviceable in presenting nearly all of the terms and phrases in common use that are likely to occur in prescriptions:

CONDENSED GLOSSARY.

Abdomen,	The belly,	Abd.
Absente febre,	Fever being absent,	Abs. feb.
Accurate,	Accurately,	Acc.
Ad,	To, or up to,	Ad.
Ad defectionem animi,	To fainting,	Ad def. an.
Ad duas vices,	At twice taking,	Ad 2 vic.
Ad gratam aciditatem,	To an agreeable sourness,	Ad. grat. acid.
Ad libitum,	At pleasure,	Ad lib.
Ad secundum vicem,	To the second time,	Ad sec. vic.
Ad tertiam vicem,	For the third time,	Ad 3 tiam vic.
Addantur,	Let (them) be added,	Add.
Adde,	Add,	Add.
Addendo,	By adding,	Add.
Addendus,	To be added,	Add.
Adhibendus,	To be administered,	Adhib.
Adjacens,	Adjacent,	Adjac.
Admove,	Apply,	Admov.

Admoveantur,	Let (them) be applied,	Admov.
Admoveatur,	Let (it) be applied,	Admov.
Adstante febre,	The fever being on,	Adst. feb.
Adversum,	Against,	Adv.
Aggrediente febre,	While the fever is coming on,	Aggred. feb.
Agitato vase,	The vial being shaken,	Agit. vas.
Aliquot,	Some,	Aliq.
Alter,	The other,	Alt.
Alternis horis,	Every other hour,	Alt. hor.
Aluta,	Leather,	Aluta.
Alvo adstricta,	The bowels being confined,	Alv. adstr.
Alvus,	The belly,	Alv.
Amplus,	Large,	Amp.
Ampulla,	A large bottle,	Ampul.
Ana,	Of each,	A. or āā.
Aqua,	Water,	Aq.
Aqua astricta,	Frozen water,	Aq. astr.
Aqua bulliens,	Boiling water,	Aq. bull.
Aqua communis,	Common water,	Aq. com.
Aqua fervens,	Hot water,	Aq. ferv.
Aqua fluvialis or fluviatilis,	River water,	Aq. fluv.
Aqua fontalis,	Spring water,	Aq. font.
Aqua fontana or fontis,	Spring water,	Aq. font.
Aqua marina,	Sea water,	Aq. mar.
Aqua nivialis,	Snow water,	Aq. niv.
Aqua pluvialis or pluviatilis,	Rain water,	Aq. pluv.
Aquarius,	Pertaining to water,	Aquarius.
Aut,	Or,	Aut.
Balneum arenæ,	Sand-bath,	B. A.
Balneum mariae or maris,	Salt-water bath,	B. M.
Balneum vaporosum or vaporis,	Vapor-bath,	B. V.
Balsamum,	Balsam,	Bals.
Barbadensis,	Barbadoes,	B. B.
Bene,	Well,	Bene.
Bibe,	Drink (thou),	Bib.
Biduum,	Two days,	Bid.
Bis,	Twice,	Bis.
Bis in die or dies,	Twice a day,	Bis die.
Bolus,	A large pill,	Bol.
Bulliat or Bulliant,	Let boil,	Bull.
Bulliens,	Boiling,	Bull.
Butyrum,	Butter,	But.
Cæruleus,	Blue,	Cærul.
Calefactus,	Warmed,	Calef.
Calomel or Calomelas,	The mild chloride of mercury,	Cal.
Cape,	Take (thou),	Cap.
Capiat,	Let him take,	Cap.
Capsula,	A capsule,	Capsul.
Caute,	Cautiously,	Caute.

Charta,	Paper,	Chart.
Chartula,	A small paper,	Chartul.
Cibus,	Food,	Cib.
Cochlear, or Cochleare,	A spoonful (ʒj),	Coch.
Cochleare amplum,	A dessert-spoonful (ʒij),	Coch. amp.
Cochleare infantum,	A child's spoonful,	Coch. inf.
Cochleare magnum,	A table-spoonful (ℨss),	Coch. mag.
Cochleare medium or modicum,	A dessert-spoonful (ʒij),	Coch. med. or mod.
Cochleare parvum,	A tea-spoonful (ʒj),	Coch. parv.
Cochleatim,	By spoonfuls,	Cochleat.
Coctio,	Boiling,	Coct.
Cola,	Strain,	Col.
Colaturæ,	To the strained liquor,	Colatur.
Colatus,	Strained,	Colat.
Coletur,	Let it be strained,	Colet.
Colentur,	Let them be strained,	Colent.
Collutorium,	A mouth-wash,	Collut.
Collyrium,	An eye-wash,	Collyr.
Coloretur,	Let it be colored,	Coloret.
Compositus,	Compound,	Comp.
Concisus,	Cut,	Concis.
Confectio,	Confection,	Conf.
Congius,	A gallon,	Cong.
Conserva,	A conserve, also Keep (thou),	Cons.
Continuantur remedia,	Let the medicines be continued,	Cont. rem.
Continueter,	Let it be continued,	Cont.
Contusus,	Bruised,	Contus.
Coque ad medietatis consumptionem,	Boil to the consumption of half,	Coq. ad Med. Consump.
Coque, Coquantur,	Boil, let them be boiled,	Coq.
Coque in sufficiente quantitate aquæ,	Boil in sufficient water,	Coq. in S. A.
Coque secundum artem,	Boil according to art,	Coq. S. A.
Cor, Cordis,	The heart,	Cor.
Cornu cervi,	Hartshorn,	C. C.
Cortex, Corticis,	The bark,	Cort.
Coxa,	The hip,	Cox.
Cras,	To-morrow,	Cras.
Cras mane sumendus,	To be taken to-morrow morning,	Cras mane sumend.
Cras nocte,	To-morrow night,	Cras nocte.
Cras vespere,	To-morrow evening,	Crasp vest.
Crastinus,	To-morrow,	Crast.
Cujus, Cujus-libet,	Of which, Of any,	Cuj.
Cum,	With,	C.
Cyatho theæ,	In a cup of tea,	Cyatho theæ.
Cyathus, or Cyathus vinarius,	A wine-glass (ℨj–ij),	Cyath., C. vinar.
Da, detur,	Give, let it be given,	D., det.
De,	Of, or from,	De.
Deaurentur pilulæ,	Let the pills be gilded,	Deaur. pil.
Debita spissitudo,	A proper consistence,	Deb. spiss.

Debitus,	Due, proper,	Deb.
Decanta,	Pour off,	Dec.
Decem, Decimus,	Ten, the tenth,	Decem, Decim.
Decoctum,	A decoction,	Decoct.
Decubitus,	Lying down,	Decub.
De die in diem,	From day to day,	De d. in d.
Deglutiatur,	Let be swallowed,	Deglut.
Dein vel Deinde,	Thereupon,	Dein.
Dejectiones alvi,	Stools,	Dej. alv.
Detur in duplo,	Let twice as much be given,	Det. in dup.
Dexter, Dextra,	The right,	Dext.
Diebis tertiis,	Every third day,	Dieb. tert.
Diebus alternis,	Every other day,	Dieb. alt.
Digeratur,	Let it be digested,	Dig.
Diluculo,	At break of day,	Diluc.
Dilue, Dilutus,	Dilute (thou), Diluted,	Dil.
Dimidius,	One half,	Dim.
Directione propriâ,	With a proper direction,	D. P. or Direct prop.
Dividatur in partes æquales,	Let it be divided into equal parts,	D. in p. æq.
Dividendus, -a, -um,	To be divided,	Divid.
Dolor,	Pain,	Dolor.
Donec,	Until,	Donec.
Donec alvus bis dejeciatur,	Until the bowels have been twice evacuated,	Donec alv. bis. dejic.
Donec alvus soluta fuerit,	Until the bowels shall be opened,	Donec alv. sol. ft.
Donec dolor nephriticus exulaverit,	Until the nephritic pain is removed,	Donec dolor. neph. exulav.
Dosis,	A dose,	D.
Drachma,	A drachm (60 grains),	Dr. or ʒ.
Durante dolore,	While the pain lasts,	Dur. dolor.
Eadem (fem.),	The same,	Ead.
Eburneus,	Made of ivory,	Eburn.
Ejusdem,	Of the same,	Ejusd.
Electuarium,	An electuary,	Elect.
Emesis,	Vomiting,	Emesis.
Enema,	A clyster or enema,	En.
Enemata,	Clysters,	Enem.
Et,	And,	Et.
Evanuerit,	Shall have disappeared,	Evan.
Exhibeatur,	Let it be exhibited,	Exhib.
Extende,	Spread,	Ext.
Extende super alutam mollem,	Spread upon soft leather,	Ext. sup. alut. moll.
Extractum,	An extract,	Extr.
Fac,	Make,	F.
Fac cataplasmatem,	Make a poultice,	F. cataplasm.
Fac pilulas duodecim,	Make 12 pills,	F. pil. xij.
Farina,	Flour,	Farina.
Fasciculus,	A small bundle,	Fasc.
Febre durante,	During the fever,	Febr. dur.
Febris,	Fever,	Febr.

Femoribus internis,	To the inner thighs,	Feb. intern.
Fervens,	Boiling,	Ferv.
Fiant,	Let them be made,	Ft.
Fiant chartulæ xij,	Let 12 powders be made,	Ft. chart. xij.
Fiant pilulæ xij,	Let 12 pills be made,	Ft. pil. xij.
Fiant pulveres xij,	Let 12 powders be made,	Ft. pulv. xij.
Fiant suppositoria iv,	Let 4 suppositories be made,	Ft. suppos. iv.
Fiant trochisci xxiv,	Let 24 troches be made,	Ft. troch. xxiv.
Fiat,	Let it be made,	Ft.
Fiat ceratum,	Let a cerate be made,	Ft. cerat.
Fiat collyrium,	Let an eye-wash be made,	Ft. collyr.
Fiat emplastrum vesicatorium,	Let a blister be made,	Ft. emp. vesic.
Fiat emulsio,	Let an emulsion be made,	Ft. emuls.
Fiat enema,	Let an enema (an injection for the rectum) be made,	Ft. enem.
Fiat injectio,	Let an injection (for the urethra) be made,	Ft. inject.
Fiat lege artis,	Let it be made by the rules of art,	F. L. A.
Fiat massa, et divide in pilulas xij,	Let a mass be made, and divide it into 12 pills,	Ft. mas. div. in pil. xij.
Fiat pulvis,	Let a powder be made,	Ft. pulv.
Fiat pulvis in chartulas xij dividenda,	Let a powder be made to be divided into xij little papers,	Ft. pulv. in chart. xij, div.
Fiat solutio,	Let a solution be made,	Ft. sol.
Fiat unguentum,	Let an ointment be made,	Ft. ung.
Fiat venesectio,	Let a bleeding be done,	Ft. venesec.
Fictilis,	Earthen,	Fict.
Filtra,	Filter (thou),	Filtra.
Filtrum,	A filter,	Filt.
Fistula armata,	A syringe ready for use,	Fistul. arm.
Flores,	Flowers,	Fl.
Fluidus,	Liquid,	Fluid., Fl.
Formula,	A prescription,	Form.
Frustillatim,	In small pieces,	Frust.
Fuerit,	Shall have been,	Fuerit.
Gargarisma,	A gargle,	Garg.
Gelatina quavis,	In any kind of jelly,	Gelat. quav.
Gradatim,	By degrees, gradually,	Grad.
Gramme,	Gram,	Gm.
Grana sex pondere,	Six grains by weight,	Gran. vj, pond.
Granum, Grana,	Grains, Grains,	Gr.
Gratus,	Pleasant,	Grat.
Gummi guttæ gambiæ,	Gamboge,	G. G. G.
Gutta, Guttæ,	A drop, Drops,	Gtt.
Guttatim,	By drops,	Guttat.
Guttis quibusdam,	With a few drops,	Gtt. quibusd.
Harum pilularum summantur tres,	Let three of these pills be taken,	Har. pil. sum. iij.
Haustus,	A draught,	Haust.
Haustus purgans noster,	A purgative draught after my own (formula),	H. p. n.

Hebdomada,	A week,	Hebdom.
Herba,	An herb,	Herb.
Herbarum recentium,	Of fresh herbs,	Herb. recent.
Heri,	Yesterday,	Heri.
Hic, Haec, Hoc,	This,	Hic, Haec, Hoc.
Hirudo,	A leech,	Hirudo.
Hora,	An hour,	H.
Horâ decubitus,	At bedtime,	Hor. decub.
Horâ somni,	At the hour of sleep,	Hor. som.
Horâ undecimâ matutinâ,	At the eleventh hour of the morning,	Hor. xj, matut.
Horæ unius spatio,	For the space of one hour,	Hor. j, spat.
Horis intermediis,	In the intermediate hours,	Hor. intermed.
Idem,	The same,	Id.
Idoneus,	Proper,	Idon.
Imprimis,	First,	Impr.
Incide, Incisus,	Cut (thou), Being cut,	Inc.
Indies,	Daily, or From day to day,	Ind.
Infunde,	Pour in,	Infun.
Infusum,	An infusion,	Infus.
Injectio,	An injection,	Injec.
Injiciatur enema,	Let a clyster be given,	Injic. enem.
In pulmento,	In gruel,	In pulm.
Instar,	Like,	Instar.
Inter,	Between,	Inter.
Internus, -a,- um,	Inner, or Internal,	Int.
Intus,	Inwardly,	Intus.
Jam,	Now,	Jam.
Julepus, Julepum, Julapium,	A julep,	Jul.
Jusculum,	A broth,	Jusc.
Juxta,	Near to,	Juxta.
Kali præparatum,	Prepared potash, or the Carbonate of potassium,	Kal. ppt.
Lac, Lactis,	Milk, of Milk,	Lac.
Lagena,	A flask or bottle,	Lag.
Lana,	Flannel, Wool,	Lana.
Languor,	Faintness,	Lang.
Lateri dolenti,	To the painful side,	Lat. dol.
Lectus,	A bed,	Lect.
Libra,	A pound,	Lb. or ℔.
Libræ,	Pounds,	Lib. or Llb.
Linimentum,	A liniment,	Linim.
Linteum,	Lint,	Lint.
Liquor,	A solution,	Liq.
Lotio,	A lotion,	Lot.
Macera,	Macerate,	Mac.
Magnus,	Large,	Mag.
Mane,	In the morning,	Mane.
Mane primo,	In the very early morning,	Mane primo.
Manipulus,	A handful,	M. or Man.
Manus,	The hand,	Manus.
Massa,	A mass or pill-mass,	Mass.
Matutinus,	In the morning,	Matut.

Medius,	Middle,	Med.
Mensura,	By measure,	Mensur.
Mica panis,	Crumb of bread,	Mic. pan.
Minimum,	A minim,	♏ or Min.
Minutum,	A minute,	Minut.
Misce,	Mix,	M.
Mistura,	A mixture,	Mist.
Mittatur,	Let (it) be sent,	Mit.
Mittantur,	Let (them) be sent,	Mit.
Mitte,	Send,	Mit.
Mitte sanguinem ad uncias duodecim saltem,	Take away blood to 12 ounces, at least,	Mit. sang. ad uncias xij, salt.
Modicus,	Middle-sized,	Modic.
Modo præscripto,	In the manner prescribed,	Mod. præsc.
Mora,	Delay,	Mora.
More dictu,	In the manner directed,	Mor. dict.
More solito,	In the usual manner,	Mor. sol.
Morturarium,	A mortar,	Mort.
Nec-non,	Also,	Necn.
Ne trades sine nummo,	Do not deliver without the money,	Ne. tr. s. num.
Nisi,	Unless,	Nisi.
Nocte maneque,	At night and in the morning,	Noct. maneq.
Non,	Not,	Non.
Non repetatur,	Let it not be repeated,	Non repetat.
Nox, Noctis,	The night, of the Night,	Nox, Noct.
Nucha,	The nape of the neck,	Nucha.
Numero,	In number,	No.
Numerus,	Number,	No.
Nux moschata,	A nutmeg,	Nux mosch.
Octarius,	A pint (℥xvj),	O., Oct.
Octavus,	Eighth,	Octav.
Octo,	Eight,	Octo.
Oleum lini sine igne,	Cold-drawn linseed oil,	Ol. lini sine ig.
Oleum olivæ optimum,	Best olive oil,	Ol. O. opt.
Omni biduo,	Every two days,	Omn. bid.
Omni bihorio,	Every two hours,	Omn. bih.
Omni horâ,	Every hour,	Omn. hor.
Omni mane,	Every morning,	Omn. mane.
Omni nocte,	Every night,	Omn. noct.
Omni quadrante horæ,	Every quarter hour,	Omn. quadr. hor.
Opus,	Need or occasion,	Opus.
Ovum,	An egg,	Ov.
Pannus,	A rag,	Pan.
Pars, Partis,	A part, of a Part,	Par., Pt.
Partes æquales,	Equal parts,	Pt. æq.
Partitis vicibus,	In divided doses,	Part. vic.
Parvulus,	An infant, A parvule,	Parvul.
Parvus,	Little,	Parv.
Pastillus, Pastillum,	A pastille,	Pastil.
Pediluvium,	A foot-bath,	Pediluv.

Penicillum camelinum,	A camel's-hair pencil or brush,	Penic. cam.
Per,	Through, By,	Per.
Per deliquium,	By deliquescence,	Per deliq.
Per fistulam vitream,	Through a glass tube,	Per fist. vit.
Peracta operatio emetici,	When the action of the emetic is finished,	Peract.operat.emet.
Pergo, Pergere,	To go on with,	Perg.
Phiala,	A vial or bottle,	Phi.
Phiala prius agitata,	The bottle having been first shaken,	P. P. A.
Pilula,	A pill,	Pil.
Pocillum,	A little cup,	Pocill.
Poculum,	A cup,	Pocul.
Pondere,	By weight,	P.
Pondus civile,	Civil weight (avoirdupois),	P. civ.
Pondus medicinale,	Medicinal weight,	P. med.
Pone aurem,	Behind the ear,	Pone aur.
Post singulas sedes liquidas,	After every loose stool,	Post sing. sed. liq.
Potus,	Drink,	Potus.
Præparata,	Prepared,	Præp.
Primo mane,	Very early in the morning,	Primo mane.
Primus,	The first,	Primus.
Pro,	For,	Pro.
Pro ratione ætatis,	According to the age of the patient,	Pro rat. æt.
Pro re nata,	Occasionally, According to circumstances,	P. r. n.
Pugillus,	A pinch,	Pug.
Pulmentum,	Gruel,	Pulm.
Pulverizatus,	Powdered,	Pulvz.
Pulvis,	A powder,	Pulv.
Pulvis patrum,	Jesuits' bark,	P. P.
Pyxis,	A pill-box,	Pyxis.
Quadrans, Quadrantis,	A quart,	Quad.
Quantum libet,	As much as you please,	Q. lib.
Quantum placet,	" " " "	Q. p.
Quantum satis,	As much as is sufficient,	Q. s.
Quantum sufficiat,	" " " "	Q. s.
Quantum vis,	As much as you please,	Q. v.
Quantum volueris,	" " " "	Q. vol.
Quâquâ horâ,	Every hour,	Qq. hor.
Quaque,	Each, or Every,	Qq.
Quartus,	Fourth,	Quart.
Quater,	Four times,	Quater.
Quatuor,	Four,	Quat.
Quibus,	From which,	Quibus.
Quinque,	Five,	Quinq.
Quintus,	The fifth,	Quint.
Quoque,	Also,	Q. q.
Quorum,	Of which,	Quor.
Quotidie,	Daily,	Quotid.
Rasuræ,	Shavings,	Ras.

Ratio,	Proportion,	Ratio.
Recens, Recentis,	Fresh,	Rec.
Recipe,	Take,	℞.
Rectificatus,	Rectified,	Rect.
Redactus in pulverem,	Reduced to powder,	Red. in pulv.
Redigatur in pulverem,	Let it be reduced to powder,	Redig. in pulv.
Regio umbilici,	The umbilical region,	Reg. umbil.
Reliquus,	Remaining,	Reliq.
Repetantur,	Let them be repeated,	Rept.
Repetatur,	Let it be repeated,	Rept.
Respondere,	To answer,	Respond.
Retinere,	To keep,	Retin.
Saltem,	At least,	Saltem.
Saturatus, -a, -um,	Saturated,	Sat.
Scatula,	A box,	Scat.
Scilicet,	Namely,	Scil.
Scrupulum,	A scruple (20 grains),	Scrup. or ℈.
Secundum artem,	According to art,	S. A.
Secundum naturam,	According to nature,	S. N.
Secundus,	Second,	Secund.
Sedes,	The alvine evacuation,	Sed.
Semel,	Once,	Semel.
Semi-drachma,	Half a drachm,	Semidr.
Semi-hora,	Half an hour,	Semih.
Semis, or Semissis,	A half,	Ss.
Septem,	Seven,	Sept.
Septimana,	A week,	Septim.
Sescuncia,	An ounce and a half,	Sescunc.
Sesquihora,	An hour and a half,	Sesquih.
Sex,	Six,	Sex.
Sextus,	Sixth,	Sext.
Si,	If,	Si.
Si non valeat,	If it does not answer,	Si non val.
Si opus sit,	If necessary,	Si op. sit.
Si vires permittant,	If the strength will bear it,	Sir. vir. perm.
Signa,	Write, or Mark (thou),	Sig.
Signatur nomine proprio,	Let it be written upon with its proper name,	Sig. nom. prop.
Simul,	Together,	Simul.
Sine,	Without,	Sin.
Singularum,	Of each,	Sing.
Singulorum,	Of each,	Sing.
Sit,	Let it be,	Sit.
Solus,	Alone,	Sol.
Solutus,	Dissolved,	Solut.
Solve,	Dissolve,	Solv.
Solvo, Solvere,	I dissolve, To dissolve,	Solv.
Somnus,	Sleep,	Somnus.
Spiritus, -ûs,	Spirit,	Spt.
Spiritus vini rectificatus,	Rectified spirit of wine (*i. e.* alcohol),	Spt. vin. rect.
Spiritus vini tenuis,	Proof spirit,	Spt. vin. ten.

Spiritus vinosus,	Ardent spirit (of any strength),	Spt. vinos.
Statim,	Immediately,	Stat.
Stet, or Stent,	Let it (or them) stand,	St.
Stratum superstratum,	Layer upon layer,	S. S. S.
Sub finem coctionis,	When the boiling is nearly finished,	Sub. fin. coct.
Subactus,	Subdued,	Subact.
Subinde,	Frequently,	Subind.
Sumantur,	Let them be taken,	Sum.
Sumat,	Let him take,	Sum.
Sumat talem,	Let him take one like this,	Sum. tal.
Sumatur,	Let it be taken,	Sum.
Sume,	Take,	Sume.
Sumendus,	To be taken,	Sum.
Summitates,	The summits,	Summit.
Superbibendo haustum,	Drinking afterward this draught,	Sup. bib. haust.
Supra,	Above,	Supra.
Syrupus, Syrupi,	Syrup,	Syr.
Tabella,	A lozenge,	Tab.
Talis,	Such a one,	Tal.
Tempori dextro,	To the right temple,	Tempor. dext.
Tempus, Temporis,	Time, or Temple,	Temp.
Ter,	Thrice, or Three times,	Ter.
Ter in die, or Ter die,	Thrice daily,	T. i. d., or T. d.
Tere,	Rub,	Tere.
Tere simul,	Rub together,	Tere. sim.
Tero,	I rub,	Tero.
Tertius,	Third,	Tert.
Tinctura,	Tincture,	Tinct. or Tr.
Tincturæ Herbarum Recentium,	Tinctures of fresh herbs,	Tinct. Herb. Recent.
Tres,	Three,	Tres.
Triduum,	Three days,	Trid.
Tritura,	Triturate,	Trit.
Trochiscus, Trochisci,	A lozenge or troche, Lozenges or troches,	Troch.
Tussis,	A cough,	Tus.
Ultimo (or Ultima) præscriptus,	The last ordered,	Ult. præsc.
Una,	Together,	Una.
Uncia,	An ounce,	Unc. or ℥.
Usque ad deliquium,	To fainting,	Usq. ad deliq.
Ut dictum,	As directed,	Ut dict.
Utendum,	To be used,	Utend.
Uto, Uti,	I use, To use,	Uto, Uti.
Vas vitreum,	A glass vessel,	Vas vit.
Vehiculum,	A vehicle or menstruum,	Vehic.
Vel,	Or,	Vel.
Venæsectio brachii,	Bleeding in the arm,	Venæsec. brach.
Vesper, Vesperis,	The evening,	Vesp.
Vices,	Turns,	Vic.

Vinum,	Wine,	Vin.
Vires,	Strength,	Vir.
Vitello ovi Solutus,	Dissolved in the yolk of an egg,	Vitel. ovi Sol.
Vitellus,	Yolk,	Vitel.
Vitellus ovi,	Yolk of an egg,	Vitel. ovi.
Vitreum, Vitrum,	Glass,	Vitr.
Vomitione urgente,	Vomiting being severe,	Vom. urg.

The arrangement of the various classes of preparations used in prescriptions has an important bearing in presenting to the mind of the reader a consistent sequence, and it is believed that the classification used by the author in his work *The Practice of Pharmacy* (1891, 2d ed.), and shown separately on page 274 of that work, is also well adapted for use in this SYSTEM OF THERAPEUTICS. Of course the scope of the present article precludes the possibility of entering into such minute observations as would only be of interest to a pharmacist, but in the consideration of the various preparations which follow sufficient information must be given of pharmaceutical operations to convey to those who are unskilled in the mysteries of the ancient art a fair conception of the processes which furnish the preparations; this much being assumed, however, that all who use this work have previously had some knowledge of pharmacy, the tendency of all modern medical education being to recognize that advances in therapeutics go hand in hand with progress in pharmacy and the elevation of both professions.

The classification referred to above first divides all official preparations into two classes—*liquids* and *solids*. Liquids are arranged according to the relative solubility of the substance in the solvent selected, the character of the solvent aiding also in the classification; simple solvents, as water, syrup, alcohol, glycerin, etc., holding the first rank. The process of percolation which is now universally used in America divides pharmaceutical preparations very naturally into classes, and as it involves only *partial solution* (the larger portion of inert matter in drugs, the ligneous fibre, being rejected), preparations in which *solution is complete* or nearly so should have the first place, because the principles involved are simpler and more direct. With these views as a guide, the first preparations to consider are the official aqueous solutions (waters and solutions and aqueous solutions containing sweet or viscid substances), then in succession liquid preparations made by solution with alcohol, ether, oils, and oleic acid as solvents; the second sub-class introduces the preparations made by percolation or maceration, and here the same order is observed: first, those made with water as a menstruum and water containing acid (infusions and decoctions and vinegars); then alcoholic percolates (tinctures, wines, and

fluid extracts), followed by ethereal preparations and the oleoresins. This completes the first division, and the solids are now considered, the first of this class being those made by the evaporation or precipitation of the percolates of the first class, and thus the sequence is maintained. The last sub-class is composed of solids made without percolation or maceration, and under this head are grouped all of the solid preparations usually made extemporaneously.

Liquids.

Aqueous Solutions.

Aquæ (Waters).—Waters, or medicated waters of the Pharmacopœia, are aqueous solutions of volatile substances, and are almost exclusively used as solvents or pleasant vehicles for the administration of various medicines. They are prepared in several different ways:

Firstly, by simple solution, agitating the volatile liquid with water until dissolved, and if necessary filtering the solution. Bitter-almond-water and creasote-water are thus prepared.

In the case of solutions of gases, the gases, after being generated in suitable apparatus, are passed through water until solutions of the proper strength are obtained.

Water of ammonia, stronger water of ammonia, and chlorine-water are prepared in this manner.

Secondly, by percolating water through oil which has previously been thoroughly distributed on cotton and firmly packed in a suitable percolator. The following waters are thus prepared: viz. anise-water, camphor-water, cinnamon-water, fennel-water, peppermint-water, and spearmint-water.

This process was substituted in the Pharmacopœia of 1880 for that formerly official, which consisted in thoroughly mixing the oil with carbonate of magnesium and water, and then filtering the solution through paper: the object of using the carbonate of magnesium was to divide the oil thoroughly, and thus expose a greater surface to the action of the water, by which means it became completely saturated.

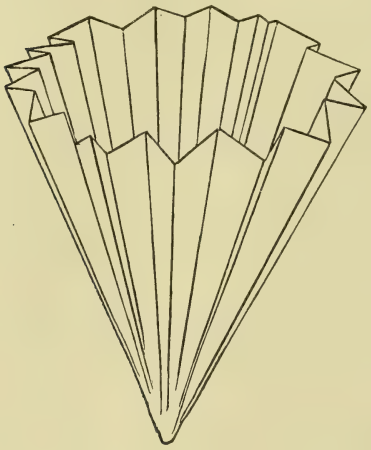
Notwithstanding the change made by the Pharmacopœia—which perhaps was not an improvement—it is feared that the great majority of pharmacists throughout the country do not follow the official directions, but adhere to the old method of using the carbonate of magnesium. The use of carbonate of magnesium was objected to on account of its slight solubility, which unfitted the water thus made for preparing certain solutions, as, for example, solution of nitrate of silver, where a slight decomposition would take place; for making such solutions, however, distilled water should at all times be used.

Instead of using carbonate of magnesium to diffuse the volatile oil,

many other substances have been proposed and used, such as magnesia, precipitated phosphate of calcium, porcelain clay, powdered silica, finely-powdered glass, powdered pumice-stone, powdered talcum or soapstone, etc.: none of these substances, however, are superior to carbonate of magnesium.

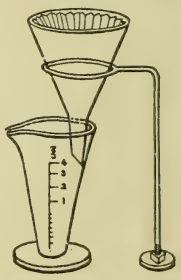
The process of filtration, so frequently performed by the pharmacist, is effected by folding bibulous paper, made especially for the purpose and termed filtering-paper, into a conical shape, as seen in Fig. 2, and then placing the filter in a funnel, moistening or washing the filter by pouring

Fig. 2.



Plaited Filter.

Fig. 3.



Arrangement of Funnel in Filtration.

water through it, and then pouring into the filter the liquid which is to be made transparent. The clear liquid flowing from the filter is termed the *filtrate.*

Fig. 3 shows a good method of supporting a funnel and filter during filtration, the end of the funnel touching the side of the graduate to prevent splashing.

Another unofficial method of making medicated waters which has been tried and recommended is that of using hot water in making the solutions. This method is founded on the fact that most of the volatile oils are much more soluble in hot than in cold water. By this plan the volatile oil is agitated with hot water in a metallic vessel or bottle until the water becomes saturated, and after standing until the oil separates, the water is separated from the excess of oil and filtered.

In prescribing, saturated solutions of salts should not be made with the medicated waters, for the reason that the waters being themselves saturated solutions, the various volatile substances from which they are prepared, not being so soluble in saturated solutions as they are in water, are precipitated, thus disturbing the transparency of the solution.

Take, for example, the following prescription:

℞.
Potassii bromidi, ʒvj ;
Aquæ camphoræ, q. s. ut ft. fʒij.
M. ft.

From this solution a portion of the camphor is precipitated, thus making an inelegant and unsightly preparation. The careful pharmacist, having prepared such a solution, would probably filter it ; this would remove the precipitated camphor, but the quantity thus removed would not be enough to make any appreciable difference either in the taste or in the dose. This difficulty may be avoided by using equal parts of water and camphor-water to make the solution.

The following prescriptions show the use of medicated waters as vehicles and solvents :

℞.
Sodii bicarb., ʒij ;
Spt. ammon. arom., fʒss ;
Syrupi, fʒj ;
Aq. menth. virid., fʒiij ;
M. Ft. in solutio.
Sig. Soda mint. A table-spoonful 3 times a day.
T. U. T.

℞.
Potassii iodidi, ʒijss ;
Syr. aurantii, fʒiij ;
Aq. cinnamom., fʒiij.
M. Ft. in solutio.
Sig. A tea-spoonful 4 times a day.
T.

℞.
Antipyrin., ʒj ;
Syrupi, fʒss ;
Aq. carui, ad fʒij.
M. Ft. in solutio.
Sig. One tea-spoonful every hour, as directed.
W.

℞.
Sodii salicylat., ʒj ;
Syrupi, fʒj ;
Aquæ menth. pip., ad fʒiij.
M. Ft. in solutio.
Sig. Two tea-spoonfuls every 3 hours.
M. L. V.

Liquores (Solutions).—"Liquores" of the Pharmacopœia are aqueous solutions of substances entirely soluble in the solvent selected, exclusive of those coming under the definitions of Waters and Syrups. To this definition there is one exception—" the solution of gutta-percha," the solvent of which is not water, but chloroform. All of the others may be separated into two classes—those which are simply solutions in water, and those in which chemical action is involved in the solution. Most of them possess active medicinal properties, and some of them are poisons. There are twenty-six official solutions : four of them contain arsenic—namely, solution of arsenious acid, solution of arsenite of potassium, solution of arseniate of sodium, and solution of iodide of arsenic and mercury ; the arsenical strength of each of these is 1 per cent. Six of the "liquores" are used only externally : these are solu-

tion of gutta-percha, solution of nitrate of mercury, solution of subacetate of lead, diluted solution of subacetate of lead, solution of chloride of zinc, and solution of silicate of sodium. The names of the other official solutions are as follows: solutions of acetate of ammonium, lime, acetate of iron, chloride of iron, citrate of iron, citrate of iron and quinine, nitrate of iron, subsulphate of iron, tersulphate of iron, citrate of magnesium, pepsin, potassa, citrate of potassium, soda, chlorinated soda, and compound solution of iodine.

℞.

Hydrarg. iodid. rub., gr. xviij;
Potassii iodidi, gr. xiv;
Aq. destill., f℥iv.
Ft. solutio.

Sig. Channing's solution. Take five drops in water 3 times a day. W. V. K.

℞.

Morphinæ sulph., gr. j;
Aq. destill., f℥j.
M. Ft. in solutio.

Sig. A tea-spoonful at night. L. A. S.

Aqueous Solutions containing Sweet or Viscid Substances.

Syrupi (Syrups).—Syrups are concentrated solutions of sugar in aqueous fluids; they are valuable preparations, being permanent when well made, their sweet taste rendering them acceptable to the palate and making them useful vehicles for the administration of many medicines.

A solution of sugar in water, of the proper strength, is called "syrupus" or syrup; other syrups take their names from the medicinal or flavoring substances from which they are prepared, and are known as medicated or flavoring syrups.

Medicated syrups are prepared from various liquids, such as infusions, decoctions, vinegars, solutions, etc., and are made in several different ways, depending in each case upon the physical condition, chemical composition, and other peculiarities of the substances employed.

Flavoring syrups are not medicinal in their action, but are used for flavoring drinks of various kinds, and are useful in disguising the taste of unpleasant medicines. They are prepared from fruits, and also from a variety of aromatic or pleasantly flavored substances.

There are thirty-four syrups official in the Pharmacopœia; in five of them the solution of sugar is effected by heat; these are "syrup," syrup of lime, syrup of raspberry, syrup of bromide of iron, and syrup of iodide of iron.

In eighteen syrups the sugar is dissolved in the medicated liquids by agitation without heat; these are the syrups of garlic, ginger, hydriodic acid, hypophosphites, lactophosphate of calcium, lemon, orange, orange-flowers, the phosphates of iron, quinine, and strychnine,

rhubarb, senna, squill, tar, wild-cherry, compound syrup of sarsaparilla, and compound syrup of squill.

Ten of the syrups are prepared by mixing the medicating substances with the syrup; they are as follows: aromatic syrup of rhubarb, syrups of acacia, citric acid, hypophosphites with iron, ipecac, krameria, lactucarium, rose, rubus, and senega. One syrup (the syrup of tolu) is made by digestion. Syrups should not be prescribed with strong alcohol, for the sugar may be thrown out of solution and precipitated, or it may crystallize out on standing.

Herewith are presented a few prescriptions illustrating the use of syrups:

℞.
Acid. phosph. dil., f℥iv;
Syr. aurant. flor., f℥iss.
Ft. solutio.
Sig. Two tea-spoonfuls in water 3 times a day. N. L.

℞.
Quinin. sulph., ℥ss;
Aq. ammon., gtt. iij;
Syr. glycyrrhizæ, f℥ij.
Fiat mistura.
Sig. Shake the bottle and take a tea-spoonful twice a day. T. R.

℞.
Sodii brom., ℨss;
Chloral. hydrat., ℥iiss;
Syr. aurantii flor., f℥ss;
Aquæ, q. s. ft. f℥ij.
Ft. solutio.
Sig. A dessert-spoonful at night in water.

℞.
Tinct. ferri chlor.,
Acid. phosph. dil., *āā.* f℥j;
Syr. limon., f℥iv.
Ft. solutio.
Sig. A dessert-spoonful in water after meals. I. F. G.

℞.
Hydrarg. chlor. cor., gr. j;
Liq. arsen. chlor., f℥j;
Tinct. ferri chlor.,
Acid. hydrochl. dil., *āā.* f℥iv;
Syr. zingiber., f℥iij;
Aquæ, q. s. ft. f℥vj.
Ft. solutio.
Sig. A dessert-spoonful in water after meals. A. H. S.

℞.
Antipyrin., ℥j;
Syr. tolut., f℥ij.
Ft. solutio.
Sig. A dessert-spoonful in water every 2 hours until relieved. V.

Mellita (Honeys).—Honey is a secretion deposited by the well-known honey-bee. It has no special medicinal value, but its pleasant taste and demulcent properties render it a pleasant vehicle for mixtures and gargles, and useful as an excipient, for which purposes, after hav-

ing been clarified, it is used in the official preparations containing it—honey of rose, confection of rose, and the mass of carbonate of iron.

℞.		℞.	
Pulv. alumin.,	gr. xx;	Sodii bor.,	gr. xx;
Mel. rosæ,	f℥j.	Mel. despum.,	f℥j.
Ft. solutio.		Ft. solutio.	
Sig. Apply to the sore mouth as directed.	M. T.	Sig. Use as directed.	N. L.

Mucilagines (Mucilages).—Mucilages are solutions in water of the gummy or mucilaginous principles of vegetable substances. They are not permanent preparations, and should not be prepared in large quantities. In pharmacy, mucilages are used as demulcents either internally or externally, as eye-washes, as excipients, and as vehicles for the administration of various remedies. There are five mucilages official, those of acacia, cydonium, and sassafras-pith being made with cold water, while those of elm and tragacanth are made with boiling water. The mucilages of acacia and of tragacanth, if not to be used for medicinal purposes, may be rendered more permanent by the addition of a small portion of creasote or volatile oil.

℞.		℞.	
Ol. terebinth.,	℥j;	Copaibæ,	f℥ss;
Pulv. sacch. alb.,	gr. xxx;	Liq. potassæ,	f℥ij;
Muc. acaciæ,	f℥ss;	Spt. æth. nit.,	f℥j;
Aquæ, q. s. ft.	f℥iv.	Tinct. opii,	f℥ij;
Ft. mistura.		Muc. acaciæ,	f℥iv.
Sig. A tea-spoonful 3 times a day.		Ft. mistura.	
		Sig. A tea-spoonful 3 times a day.	F. F. M.

Misturæ (Mixtures).—Mixtures are aqueous preparations in which insoluble materials are mechanically suspended. Under this heading the Pharmacopœia includes mixtures containing oleaginous matters, which, being distinctive, should be separated from mixtures and classified under the title "Emulsions." The term "mixture" is frequently applied, but pharmaceutically incorrectly so, to perfect solutions where two or more ingredients are mixed together. The special purpose of mixtures is to disguise the taste of unpleasant remedies or to facilitate their admininistration, the vehicle used being generally of a syrupy or mucilaginous character, whereby the insoluble substances are held in suspension. Mixtures are mostly extemporaneous preparations, and cannot be kept long; they should therefore be made in only such quantities as are immediately wanted.

The official mixtures are as follows: chalk, compound iron, com-

pound mixture of glycyrrhiza, magnesia, and asafetida, acetate of iron and ammonium, almond, ammoniac, asafetida, chloroform, citrate of potassium, and rhubarb and soda. Of these the mixture of acetate of iron and ammonium is improperly named; it, being a perfect solution, should be classed among the "Liquores," while, as we have said before, the following mixtures should be named emulsions: viz. almond, ammoniac, asafetida, and chloroform. This last-named substance, not being oily in its character, is nevertheless made into an emulsion by means of the yolk of egg. Emulsions are prepared by making a thick mucilage of acacia with water, and then very slowly and gradually introducing the oily substance to be emulsified, stirring constantly with a light motion, without using pressure (see Fig. 4), the object being to entangle the globules of oil and envelop each one with a thin layer of mucilage; these enveloped globules float in the water, and then resemble closely the type of all emulsions, cow's milk or cream.

Fig. 4.



Emulsion Mortar and Pestle.

The following are illustrations of methods of prescribing mixtures:

℞.

Res. guaiaci,	gr. xlv;
Pulv. acaciæ,	
Pulv. sacch. alb.,	āā. gr. xl;
Aq. cinnamomi,	f℥iv.

Ft. mistura.

Sig. A tea-spoonful 3 times a day.

N. G. W.

℞.

Ol. picis liq.,	f℥j;
Chloroform.,	♏xx;
Ol. menth. pip.,	♏v;
Pulv. ext. glycyrrh.,	ʒij;
Pulv. sacch. alb.,	℥j;
Alcoholis,	f℥ss;
Acaciæ,	q. s.
Aquæ, q. s. ft.	f℥iv.

M. Ft. mistura.

Sig. A tea-spoonful 3 times a day.

W. K. T.

Glycerita (Glycerites).—Glycerites are mixtures or solutions of medicinal substances made with glycerin. Only two are official—the glycerite of starch, which is made by first mixing thoroughly starch and glycerin, and afterward heating the mixture until the starch-granules are completely dissolved; and the glycerite of yolk of egg, which is made by rubbing the two ingredients together until thoroughly

mixed. Possessing demulcent and emollient properties, both of them are used as protective local applications to irritated surfaces, while the glycerite of yolk of egg has been recommended as a basis for emulsionizing cod-liver and other oils.

Formerly glycerites of borax and tannic acid were official; both of these were useful and valuable preparations, and even now are perhaps more used than are the official glycerites.

Formulas for both of them are given in the National Formulary:

℞.		℞.	
Boroglycerid.,	f℥ij;	Acidi tannici,	℥j;
Glycerini,	f℥vj.	Glycerini,	f℥ss.
Ft. solutio.		Ft. solutio.	
Sig. Apply as directed.	V. T.	Sig. Use as directed.	M. L.

℞.		℞.	
Ol. morrhuæ,	f℥j;	Ext. belladon.,	gr. xij;
Spt. frumenti,	f℥ss;	Ext. opii,	gr. vj;
Glycerit. vitelli,	f℥iss;	Glycerit. amyli,	℥ss.
Ft. emulsio.		Ft. unguentum.	
Sig. A table-spoonful after meals.	W. N. H.	Sig. Use as directed.	E. W.

Alcoholic Solutions.

Spiritus (Spirits).—"Spirits" of the Pharmacopœia are alcoholic or hydro-alcoholic solutions of volatile substances, and are prepared either by solution or distillation.

The principal use of the aromatic spirits is to give agreeable taste and flavor to medicines of various kinds or to correct their nauseating or griping tendencies.

Spirits should not be prescribed with aqueous mixtures without carefully considering the relative quantities of each, or the oily substance will be apt to be thrown out of combination; the addition of gum or other emulsionizing substance is then proper to prevent separation at the time of administering.

Nearly all of the official spirits are made by solution, only one (the spirit of nitrous ether) being made by chemical action and two (brandy and whiskey) by distillation. The other official spirits are as follows: spirits of ammonia, anise, camphor, chloroform, cinnamon, ether, gaultheria, juniper, lavender, lemon, myrcia, nutmeg, peppermint, and spearmint; aromatic spirit of ammonia, compound spirit of ether, compound spirit of juniper, and perfumed spirit. The following prescriptions illustrate various methods of administering spirits:

℞.

Potassi acet.,	ʒij ;
Spt. junip. comp.,	fʒiv ;
Spt. æth. nit.,	fʒj ;
Infus. scoparii,	fʒiv.

Ft. solutio.

Sig. Two table-spoonfuls thrice daily. W. H. D.

℞.

Chloroformi,	
Spt. ammon. arom., *āā.*	fʒiv ;
Tinct. opii camph.,	
Spt. ætheris comp., *āā.*	fʒj ;
Ovi vitelli,	j.

Ft. mistura.

Sig. A tea-spoonful as required. E. H.

℞.

Spt. chloroformi,	
Tinct. card. comp., *āā.*	fʒij.

Sig. A tea-spoonful every half hour until relieved. B.

℞.

Morph. sulph.,	gr. iss ;
Ext. cannabis,	gr. x ;
Spt. ammon. arom.,	♏ xx ;
Spt. ætheris,	fʒj ;
Spt. gaultheriæ,	fʒiss.

Ft. solutio.

Sig. Half a tea-spoonful at night. W. W.

℞.

Spt. camphoræ,	fʒj ;
Lin. saponis,	fʒiij ;

Ft. linimentum.

Sig. Use as directed. L. E. A.

℞.

Bismuth. subnit.,	ʒj ;
Cretæ præparatæ,	ʒij ;
Spt. menth. vir.,	fʒij ;
Syrupi,	fʒiv ;
Aquæ, q. s. ft.	fʒiv.

Ft. mistura.

Sig. A tea-spoonful every 4 hours. M.

Elixiria (Elixirs).—Elixirs are liquid preparations containing sugar and alcohol, usually combined with aromatics, and generally not possessing much medicinal activity, their particular object being to disguise or render pleasant to the taste medicines otherwise disagreeable. Of late years they have been very extensively used, being pleasing to the eye as well as fragrant and palatable.

Only one elixir is official in the Pharmacopœia, although in the National Formulary no less than eighty-six formulas are given, many of which, though used in some parts of the country, contain substances which are totally unfitted to be made into elixirs. The official preparation is "elixir of orange," which is a very pleasant elixir, and is designed simply as a vehicle for other substances. Illustrations of the methods of prescribing elixirs are appended on the following page :

℞.

Lithii citratis, ʒij;
Elix. aurantii, fʒiij.
Ft. solutio.

Sig. A tea-spoonful 4 times a day.
N. W.

℞.

Antipyrin., ʒj;
Elix. aurantii, fʒj.
Ft. solutio.

Sig. A tea-spoonful every 2 hours, as directed. B. N. W.

℞.

Potass. acet., ʒiiss:
Ext. junip. fld., fʒss;
Elix. aurantii, fʒiv;
Aquæ, q. s. ft. Oss.

Sig. A dessert-spoonful 3 times a day. P. S. T.

℞.

Quininæ sulph., gr. xvj;
Cinchonidin. sulph.,
Cinchoninæ sulph., āā. gr. viij;
Elix. aurantii, Oj.
Ft. solutio.

Sig. A tea-spoonful 3 times a day.
M. M.

℞.

Potass. brom., fʒv;
Acid. citric., gr. viij;
Elix. aurantii, q. s. ft. fʒiv.
Ft. solutio.

Sig. A tea-spoonful as required.
O. R. L.

℞.

Ext. paulliniæ fld., fʒiss;
Ext. glycyrrhizæ fld., fʒss;
Elix. aurantii, fʒvj.
Ft. mistura.

Sig. A tea-spoonful every 3 hours.
W. S. R.

Ethereal Solutions.

Collodia (Collodions).—Collodions are liquid preparations used for external application. They are made by dissolving pyroxylin or gun-cotton in a mixture of ether and alcohol, and are variously medicated, being thus made the vehicles of several important medicines. When applied to the skin the ether and alcohol evaporate, leaving a thin film, which either acts as a protection to the surface below or brings a medicinal agent in contact with the part to which it is applied. The following collodions are official: Collodion, collodion with cantharides, flexible collodion, and styptic collodion. Ordinary collodion produces a film which is slightly contractile; flexible collodion contains a trace of castor oil and Canada turpentine: these being non-volatile, the film is rendered softer and somewhat elastic. Flexible collodion is used when a covering for the epidermis is needed which will allow of some motion of the part, as, for instance, upon an abraded knuckle. Several other forms of collodions have come into use for special purposes, as carbolized collodion and iodoform collodion.

Herewith are presented some of the modes of prescribing collodions:

℞.
Collod. c. canth., f℥ss.
Sig. Apply with a camel's-hair brush, as directed.
T. N.

℞.
Tinct. iodi.,
Spt. ammoniæ,
Collodii, *āā.* f℥ij.
M.
Sig. Apply at night, as directed.
V. V.

℞.
Acid. carbolic., gtt. ij;
Collod. flexilis, f℥ss.
M.
Sig. Apply as directed.
L. A.

℞.
Iodoformi, gr. v;
Collod. flexilis, f℥ij.
Ft. solutio.
Sig. Brush upon the part, as directed.
M. K.

Oleaginous Solutions.

Linimenta (Liniments).—Liniments are preparations to be applied to the skin, usually by friction, and are generally liquid or of such consistence as to become liquefied when applied. They are largely used and are valuable preparations, most of them being beneficial not only on account of their intrinsic merits, but because the friction usually employed in their application induces more or less counter-irritation.

The following official liniments may be used by inunction: ammonia, belladonna, camphor, chloroform, subacetate of lead, soap, and compound liniment of mustard.

Lime liniment and liniment of turpentine are used for burns, and are simply applied to the affected parts.

Liniments may be prescribed as follows:

℞.
Thymol., ℥ss;
Ol. terebinth., f℥ij;
Ol. origani, f℥iv;
Ol. gossypii, f℥v.
Ft. linimentum.
Sig. Rub into the affected parts.
A. W. L.

℞.
Tinct. aconiti,
Chloroformi,
Aq. ammoniæ, *āā.* f℥ij;
Linim. saponis, q. s. ft. f℥viij.
Ft. linimentum.
Sig. Use as directed, locally.
N. W.

℞.
Lin. aconiti,
Lin. belladonnæ, *āā.* f℥ij;
Lin. saponis, q. s. ft. f℥ij.
Ft. linimentum.
Sig. Apply as directed.
C. E. M.

℞.
Ol. tereb., f℥iij;
Ovi vitelli, j;
Ol. limon., ♏.xxx;
Acid. acetic., f℥v;
Aq. rosæ, f℥iiss.
Ft. linimentum.
Sig. Apply as directed.
A. C. B.

Oleata (Oleates).—Oleates are preparations made by dissolving alkaloids or metallic oxides in oleic acid. Some are solid and some are liquid; the only two which are official, oleate of mercury and oleate of veratrine, are liquid, being solutions of the oleates in an excess of oleic acid. They have been recommended as being more readily absorbed when applied to the skin, and therefore quicker and more efficient in their action, than ordinary ointments prepared with other fatty bodies, while at the same time they are more cleanly in their application.

Some of the unofficial oleates are compounds containing oleic and stearic acids; these are usually in the form of fine powder.

The following prescriptions exhibit the use of oleates:

℞.
Zinci oleati,
Talci præparati, *āā.* ʒss.
Misce et fiat pulv. subtil.
Sig. Dust upon the part night and morning. U.

℞.
Cupri oleati, ʒi;
Petrolati, ʒiij.
Ft. unguent.
Sig. Apply with caution night and morning. R. A. S.

℞.
Oleati veratrin., fʒss.
Sig. Apply with a camel's-hair brush, as directed. M. N.

℞.
Hydrargyri oleati (20%), ʒss;
Lanolini, ʒiiss.
Ft. unguent.
Sig. Apply 3 times daily. V. W. R.

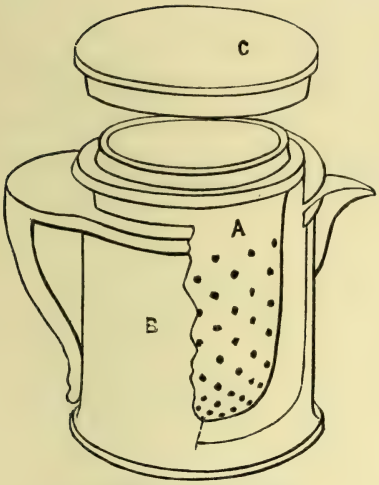
Aqueous Liquids made by Percolation or Maceration.

Infusa (Infusions).—Infusions are solutions of the soluble principles of drugs, either in cold or hot water, made without boiling. They are not permanent preparations, undergoing decomposition in a short time, and should not be prepared in larger quantities than the immediate occasion demands.

Infusions of drugs which contain either volatile principles or principles that are injured by heat should be made with cold water. Infusions can be made more quickly by the use of hot water, but in consequence of the solution of extractive and inert matters which are very slowly deposited when the infusions cool, preparations thus made are not clear, the precipitated particles being so minute that they cannot be separated by straining or filtration.

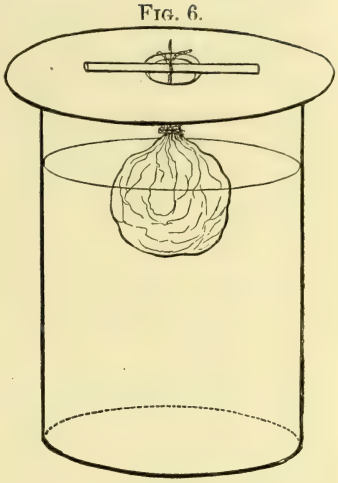
The official processes for infusions are maceration and percolation. By maceration is meant soaking a drug in a menstruum until it is softened and the soluble portion is dissolved. Fig. 5 shows Squire's infusion mug. The substance to be infused is deposited in the queensware colander A; this is placed then in the mug B; hot or cold water poured over it, the cover C put in position, and the whole allowed to stand for the required length of time. In Fig. 6 a simple method of

Fig. 5.



Squire's Infusion Mug.

Fig. 6.



Circulatory Solution.

making an infusion which obviates the necessity of straining is shown. The substance, properly comminuted, is tied in a piece of cheese-cloth or muslin, as shown, and then suspended at the top of the liquid. The liquid in contact becomes saturated, falls to the bottom, and fresh liquid takes its place, a circulatory solution being effected. In Fig. 7 an application of this principle for making hot infusions is shown. There are five official infusions, three of which are made by maceration in boiling water: these are infusion of digitalis and compound infusion of senna, both of which are directed, after maceration, to be strained; and infusion of brayera, which is directed to be dispensed without straining. The other two are made by percolation with cold water, the infusion of cinchona without previous maceration, a small quantity of aromatic sulphuric acid being added to the water for the purpose of rendering the alkaloids more soluble; and the infusion of wild cherry, which is allowed to macerate for one hour before percolation.

Fig. 7.



Infusion Mug (home-made).

The process of digestion is frequently used in preparing infusions, and consists in macerating the infused substance in water for a length

of time at a moderately elevated temperature, below boiling heat, the solvent powers of the menstruum being thereby increased.

Another process of making infusions is frequently adopted, that of diluting fluid extracts with water. This plan, as a general rule, is a bad one, and not to be justified unless the active principles of the drug were equally soluble in alcohol and in water, which would very rarely be the case; it should never be followed when an official infusion is prescribed.

℞.

Potass. brom., ℥ss;
Inf. gent. comp., f℥viij.
Ft. solutio.

Sig. A dessert-spoonful every 4 hours. G. M.

℞.

Ext. pilocarpi fld., f℥j;
Inf. buchu, f℥vss.
Misce.

Sig. Two table-spoonfuls every 4 hours. A. R. L.

℞.

Potass. chlor., ʒss;
Inf. rosæ comp., f℥iv.
Ft. gargarisma.

Sig. Use as directed. V. T.

℞.

Tr. aconit. rad., f℥ss;
Inf. digitalis, f℥iv.
Misce.

Sig. A table-spoonful every 4 hours. W. K.

Decocta (Decoctions).—Decoctions are liquid preparations made by boiling drugs with water. These, like infusions, are not permanent preparations, being decomposed even more quickly than infusions. Many substances yield their soluble portions more readily and completely to the continued action of boiling water than if the temperature is lower, and therefore, where haste is important or where the active principles of the drug are with difficulty extracted, decoction is preferable to infusion. Many drugs, however, are injured by heat, a portion of their active principles being either destroyed or rendered inert, while at the same time the decoction becomes loaded with starchy and gummy matters that have no medicinal activity. Decoctions are perhaps more used as domestic remedies than they are prescribed by physicians. While there is a general formula given in the Pharmacopœia for the preparation of decoctions, there are only two which are official: these are decoction of cetraria and compound decoction of sarsaparilla.

The official general formula is as follows:

An ordinary decoction, the strength of which is not directed by the physician nor specified by the Pharmacopœia, shall be prepared by the following formula:

Take of

The substance, coarsely comminuted, ten parts, 10;
Water, a sufficient quantity to make one hundred parts, 100.

Put the substance into a suitable vessel provided with a cover; pour

upon it one hundred (100) parts of cold water; cover it well, and boil for fifteen minutes; then let it cool to about 45° C. (113° F.); strain the liquid, and pass through the strainer enough cold water to make the product weigh one hundred (100) parts.

Caution.—The strength of the decoctions of energetic or powerful substances should be specially prescribed by the physician.

The following are prescriptions for decoctions:

℞.

Hydrarg. chlor. cor.,	gr. j;
Potassii iodid.,	ʒij;
Decoct. sarsap. comp.,	Oj.

Ft. decoctio.

Sig. Two tablespoonfuls 3 times a day.

F. F. M.

℞.

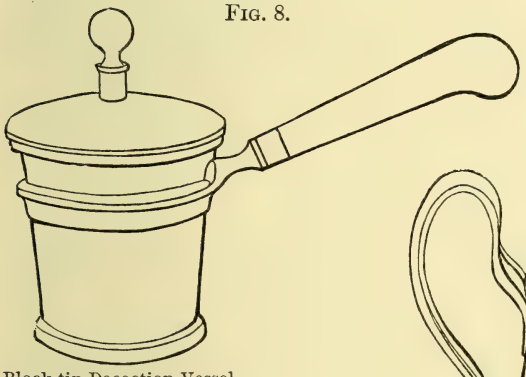
Ext. aloes. aq.,	ʒj;
Myrrhæ,	
Croci,	*āā.* gr. xlv;
Potass. carb.,	ʒss;
Ext. glycyrrhiz.,	ʒiv;
Tinct. card. comp.,	fʒiv;
Aquæ, q. s. ft.	fʒviij.

Ft. decoctio.

Sig. A tablespoonful at night.

V. T.

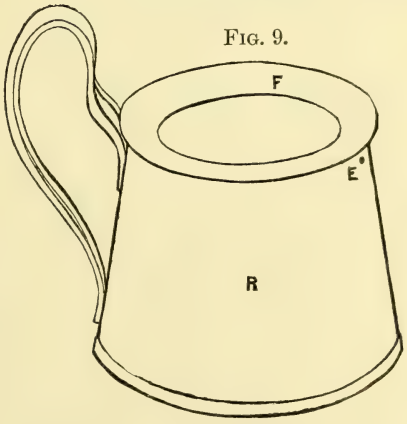
Fig. 8.



Block-tin Decoction Vessel.

Figs. 8 and 9 show apparatus for preparing decoctions. Fig. 8 represents a vessel made of solid block tin; it has a cover and a long wooden handle. The drug is placed in the vessel, covered with water, and heated; if care is necessary to prevent too much heat, the vessel is heated in the water-bath R (Fig. 9), which is kept nearly full of water.

Fig. 9.



Brass Water-bath.

Aceta (Vinegars).—The medicated vinegars of the Pharmacopœia are solutions of the active principles of drugs in vinegar or acetic acid. Vinegar is a solvent of many substances that are insoluble in water. It is a good solvent of alkaloids, which it converts into acetates, and thereby perhaps renders them more active without essentially modify-

ing their remedial action. In consequence of the variable strength of vinegar, and at the same time of its containing impurities and vegetable principles that are very liable to decomposition, the official vinegars are directed to be made with diluted acetic acid, and are thereby rendered much more uniform and stable.

There are four vinegars official—namely, those of lobelia, opium, sanguinaria, and squill; the strength of each of these is 10 per cent. of the drug, and they are all directed to be made by percolation. These preparations are not very frequently prescribed, but the vinegar of squill is largely used in preparing the syrup of squill, which is a popular remedy extensively employed.

When it is undesirable to introduce alcohol into the system—which would occur if tinctures or fluid extracts were used—or when a small quantity of acid is needed, the vinegars are useful preparations. They are usually prescribed in combinations somewhat similar to those in the following formulas:

℞.		℞.	
Morph. acet.,	gr. j;	Acet. opii,	f℥j;
Acet. scillæ,	f℥ss;	Acet. lobeliæ,	f℥j;
Syr. ipecac.,	f℥j;	Syr. senegæ,	f℥ss;
Syr. tolu., q. s. ft.	f℥iv.	Syrupi, q. s. ft.	f℥iv.
M. Ft. solutio.		M. Ft. mistura.	
Sig. A tea-spoonful when the cough is troublesome.		Sig. A tea-spoonful 3 or 4 times a day.	
V.		W.	

Alcoholic Liquids made by Percolation or Maceration.

Tincturæ (Tinctures).—Tinctures, according to the Pharmacopœia, are alcoholic or hydro-alcoholic solutions of medicinal substances. Alcohol is perhaps the best solvent of the active principles of most vegetable drugs, dissolving active principles that are not soluble or are slightly soluble in water, while it does not dissolve various inert substances that are soluble in water; thus, essential oils, resins, or oleo-resins require strong alcohol as the solvent, being practically insoluble in water. On the other hand, diluted alcohol—*i. e.* alcohol diluted with an equal volume of water—is used in preparing many of the tinctures, in preference to strong alcohol, since it dissolves more of the active principles which are soluble in water, and many drugs contain principles which are most soluble in diluted alcohol; as, for example, drugs which contain tannin or extractive matter, or the natural salts of the organic alkaloids combined with essential oils or resin; in such cases alcohol diluted with water would be the most proper solvent.

Diluted alcohol contains a sufficient quantity of alcohol to preserve

preparations made with it from change or decomposition, is cheaper, and has the further advantage of giving less alcohol in the dose.

Active medicines, or those of which the dose is small, are very conveniently administered in tinctures; the amount of alcohol in them is inappreciable, but in the tinctures of the weaker medicines the amount of alcohol to be given is in many cases so great as to be objectionable, and other means of presenting the medicines is desirable; in such cases the fluid extracts are often available.

Tinctures have always been popular as medicines, and of fifty-one tinctures official in the United States Pharmacopœia of 1820, forty-two are still official in the present Pharmacopœia.

Most of the tinctures are directed to be made by percolation, the drugs, in powder, having been previously allowed to macerate for a short time; when the process is skilfully performed the result is satisfactory and leaves nothing to be desired. The following is a list of the tinctures directed to be prepared in this manner:

Tincture of aconite,
" arnica-flowers,
" arnica-root,
" bitter orange-peel,
" sweet orange-peel,
" belladonna,
" bryonia,
Compound tincture of catechu,
Tincture of chirata,
" cimicifuga,
" cinchona,
Compound tincture of cinchona,
Tincture of cinnamon,
" colchicum,
" saffron,
" conium,
" cubeb,
" digitalis,
" nutgall,
" calendula,
" calumba,
" Indian cannabis,
" cantharides,
" capsicum,
" cardamom,
Compound tincture of cardamom,
Tincture of nux vomica,
" opium,
Deodorized tincture of opium,
Tincture of physostigma,
" pyrethrum,
" quassia,
" rhubarb,
Aromatic tincture of rhubarb,
Sweet tincture of rhubarb,
Tincture of sanguinaria,
" squill,
" serpentaria,
" gelsemium,
Compound tincture of gentian,
Tincture of hops,
" hydrastis,
" hyoscyamus,
" ignatia,
" krameria,
Compound tincture of lavender,
Tincture of lobelia,
" matico,
" musk,
" myrrh,
" stramonium,
" sumbul,
" valerian,
Ammoniated tincture of valerian,
Tincture of vanilla,
" veratrum viride,
" ginger.

In the hands of inexperienced operators the plan of maceration with frequent agitation will be found more satisfactory. In this method,

however, there will always be more or less loss, since there will always be a portion of the liquid retained in the dregs, however thoroughly they may be expressed after maceration.

Gums and gum-resins, owing to their adhesive nature, are not easily percolated, and consequently the tinctures of these are directed to be made by maceration; and seven days is the length of time specified for most of them.

The following tinctures are thus prepared, and after maceration are separated from the dregs by filtration through paper:

Tincture of aloes,
" aloes and myrrh,
" asafetida,
" benzoin,
Compound tincture of benzoin,
Tincture of guaiac,
Ammoniated tincture of guaiac,
Tincture of myrrh,
Camphorated tincture of opium,
Deodorized tincture of opium.

The same length of time is not necessary for such substances as are almost wholly soluble in alcohol; thus, tincture of kino and tincture of green soap are directed to macerate only until the respective drugs are dissolved. In the case of tinctures of fresh herbs a longer maceration is necessary, and the Pharmacopœia has extended the time to fourteen days.

The following, although classed among the tinctures, are simply solutions of substances that are perfectly soluble, and therefore would more properly be called alcoholic solutions:

Tincture of acetate of iron,
" chloride of iron,
Tincture of iodine,
" tolu.

Tinctures are prescribed so largely, and differ so much in physical properties, that no general rules can be formulated for their proper combination. Resinous tinctures should not be directed to be mixed with aqueous solutions without providing for the suspension of the precipitated resin by the use of sufficient acacia; hydro-alcoholic tinctures and resinous tinctures should not be mixed together for the same reason. Mucilage of acacia and strong syrup are precipitated if mixed with tinctures containing strong alcohol.

The following prescriptions exhibit some of the forms in which tinctures are prescribed:

℞.
Tinct. digital., f℥ss;
Ext. ergotæ fld., f℥iiiss.
M.
Sig. A tea-spoonful thrice daily.
B.

℞.
Tinct. strophanthi, f℥j.
Sig. Five drops 3 times daily.
F.

℞.

Tinct. krameriæ,	f℥iv ;
Tinct. opii,	f℥ij ;
Mist. cretæ, q. s. ft.	f℥iij.

M.

Sig. A tea-spoonful 3 times a day.

℞.

Tinct. guaiaci,	f℥ss ;
Ext. cannabis,	gr. xvj ;
Syr. tolut.,	f℥j ;
Pulv. acaciæ,	q. s.
Aquæ, q. s. ft.	f℥ij.

M. Ft. mistura.

Sig. A tea-spoonful in water.

F. F. V.

℞.

Tinct. iodi co.,	f℥ss ;
Aq. ammon. fort.,	f℥ss.

M.

Sig. Apply externally with a camel's-hair brush. M. B. M.

℞.

Tinct. cantharidis,	f℥ij ;
Tinct. ferri chlor.,	f℥vj.

M.

Sig. Twenty drops in water through a glass tube, thrice daily.

H. C. W.

℞.

Tinct. gelsemii,	f℥j ;
Tinct. belladon.,	f℥ij.

M.

Sig. Fifteen drops at bedtime.

A. R. T.

Vina Medicata (Medicated Wines).—Medicated wines are solutions in wine of the soluble principles of medicinal substances. They contain less alcohol than tinctures, and are therefore less stimulating, while there is enough alcohol in them to render them much more permanent than infusions or decoctions. Most wines are liable to undergo decomposition, more especially when imbued with the soluble principle of vegetable drugs. White wine is the kind directed to be used in making the wines of the Pharmacopœia, and in order to make these preparations more permanent its alcoholic strength is increased by the addition of 1 part of alcohol to 7 parts of wine; this preparation is known as Vinum Album Fortius, or stronger white wine, and is required to contain not less than 20 per cent., nor more than 25 per cent., of alcohol.

In the Pharmacopœia previous to 1880 the imported wines sherry and port were official, sherry being used as the menstruum for preparing the medicated wines; but no directions were given respecting the amount of alcohol contained in it, and consequently the medicated wines as usually found were very variable in alcoholic strength, and very often had not enough alcohol to preserve them. But in 1880 the committee of revision decided not to recognize any special variety of wine, and adopted the titles "vinum album" (white wine) and "vinum rubrum" (red wine), and permitted any wine to be used, whether imported or not, provided it was sufficiently pure and had the required alcoholic strength.

There are fourteen official wines; of these, three are not medicated—viz. white wine, stronger white wine, and red wine; four are prepared by percolation—aromatic wine and the wines of colchicum-root, ergot, and rhubarb; three are prepared by maceration—viz. the wines of aloes, colchicum-seed, and opium; and the remaining four are made by simple solution or admixture; these are bitter wine of iron, wines of antimony, citrate of iron, and ipecac.

The following illustrations show the use of medicated wines:

℞.

Morph. sulph.,	gr. j;
Vin. colchici,	f℥j;
Magnesiæ,	℥j;
Aq. menth. pip.,	f℥iv.

Misce.

Sig. A table-spoonful thrice daily.

W. T. B.

℞.

Tinct. nuc. vom.,	f℥iv;
Syr. tolut.,	f℥ij;
Vin. ferri, q. s. ft.	f℥iv.

Misce.

Sig. A tea-spoonful after meals.

B. B. N.

℞.

Syr. scillæ,	f℥j;
Syr. picis liq.,	f℥iss;
Tinct. opii,	f℥ij;
Vin. antimonii,	f℥ss.

Ft. mistura.

Sig. A tea-spoonful at night.

W. V. K.

℞.

Sod. borat.,	gr. ij;
Vin. opii,	gtt. v;
Aqua dest.,	f℥j.

Ft. collyrium.

Sig. Drop in the eye as directed.

M. L. V.

Extracta Fluida (Fluid Extracts).—This class of preparations is the largest and one of the most important, if not the most important one, in the United States Pharmacopœia. Having been made official for the first time in 1850, when seven were introduced, they have so increased in popularity and number that formulas for preparing seventy-nine are given in the U. S. P. of 1880, and for fifty-two others in the National Formulary, in addition to which there have been placed upon the market by various manufacturers an endless variety of fluid extracts of almost all the vegetable drugs that are known to medical science.

Fluid extracts are alcoholic or hydro-alcoholic solutions of the soluble principles of vegetable drugs, of such strength that 1000 grammes of drug are fully represented by 1 litre of fluid extract, or 1 gramme by a cubic centimetre (a millilitre). This is a slight change of strength from the Pharmacopœia of 1870. At that time the fluid extracts were to be made so that each minim represented one grain of the drug; but as there exists no fixed relation between minim and grain, it was thought best to adopt the metric system, in which one gramme is the exact weight of one cubic centimetre of distilled water;

to express this relation more clearly the term fluigram has been proposed. This involved a change of 5 per cent., the strength being thereby rendered 5 per cent. weaker—a change not sufficient to be appreciated in dosage.

The great advantage of fluid extracts over other liquid preparations of the same drug consists in their concentration and consequent convenience, their permanence, and in the uniform relation of their strength to the drugs from which they are prepared. They are much more concentrated than tinctures, and are thereby rendered more portable; at the same time the dose required is much smaller and contains less alcohol, which in many cases is contraindicated therapeutically. Inasmuch as they fully represent the drugs from which they are prepared by containing all their soluble principles, they are in very many cases superior to the various alkaloids and active principles, which are generally only partial representatives of the medicinal activity of these drugs.

The subject of menstrua (the liquids used to extract the soluble principles) has been carefully studied, and very many experiments have been made with the view of ascertaining the best menstruum for each individual fluid extract. Some drugs require much stronger alcohol to exhaust them than others, and with all, when an alcoholic menstruum is used, a sufficient amount is taken to exhaust the drug thoroughly, and enough alcohol is allowed to remain in the finished extract to render it permanent; this latter object is still further ensured by the addition in some cases of a small quantity of glycerin to the menstruum.

Some drugs—as, for example, triticum and castanea—are best exhausted by boiling water, and in these cases, after exhausting the drugs by percolation, the liquid is evaporated to the proper degree, and to preserve it a sufficient quantity of alcohol is added to make the finished product contain 20 per cent.

The official process for making fluid extracts is by percolation, and, as described in the Pharmacopœia, consists in subjecting a substance in powder, contained in a vessel called a percolator, to the solvent action of a menstruum in such a manner that the liquid as it passes through the powder in its descent to the recipient shall be charged with the soluble portion of it, and be free from insoluble matter. The following is given as a typical formula:

One hundred grammes of a drug reduced to the proper degree of fineness having been moistened with a specific quantity of menstruum, are carefully packed in a suitable percolator, and a sufficient quantity of menstruum added thoroughly to saturate the powder. When the liquid begins to drop from the percolator, the lower orifice is closed with a cork, and the drug is allowed to macerate for a certain time; additional menstruum is then poured on, and, the cork having been removed, perco-

lation is continued until the drug is exhausted. Ordinarily, the first 70 to 90 c.c. of liquid passing through are reserved, and the remainder, having been evaporated to the consistence of a soft extract, is dissolved in the reserved portion. A sufficient quantity of menstruum is then added to make the whole measure 100 c.c.

The value of the resulting fluid extract will of course depend upon the manner in which the prescribed directions are followed; and, with a proper selection of the drug, if the process of percolation is carefully and skilfully conducted, the results cannot fail to be satisfactory.

℞.
Ext. uvæ ursi fld., f℥j;
Ext. tritici fld., f℥ij.
Misce.
Sig. A tea-spoonful in water 3 times a day. O. K.

℞.
Potass. acet., ʒij;
Ext. buchu. fld., f℥ij.
Ft. solutio.
Sig. A tea-spoonful 4 times a day. L. L.

℞.
Ext. verat. virid. fld., f℥ss.
Sig. Two drops in water, as directed. B. K. S.

℞.
Ext. erythroxyli fld., f℥j;
Vin. xerici,
Syr. tolut., āā. f℥iij.
Misce.
Sig. A tea-spoonful 4 times a day. W. B. K.

℞.
Ext. lactucæ fld., fʒvj;
Syr. scillæ, f℥iss;
Tinct. opii, f℥ss;
Syr. pruni virg., q. s. ft. f℥iv.
Misce.
Sig. A tea-spoonful when the cough is troublesome. L. D.

℞.
Ext. rhei aromat. fld., f℥j;
Ext. aromat. fld., fʒiv;
Syrupi, fʒvij.
Misce.
Sig. A tea-spoonful 3 times a day. W. N.

℞.
Ext. aconit. fld., fʒvj;
Lin. saponis, fʒiv.
Ft. liniment.
Sig. Apply as directed. W. N. T.

℞.
Ext. digital. fld., fʒij;
Ext. aconit. rad. fld., fʒvj.
Misce.
Sig. Two drops in water 3 times a day. V. W. M.

℞.
Ext. grindeliæ fld., fʒiv;
Aquæ font., f℥vss.
Misce.
Sig. Apply constantly to the inflamed surface. W. R.

℞.
Ext. pilocarpi fld., fʒij;
Liq. potass. cit., f℥iij.
Misce.
Sig. A tea-spoonful every two hours. V. M.

℞.
Potass. chlor., ʒj;
Ext. rhois glab. fld., fʒss;
Inf. rosæ comp., q. s. ft. fʒiv.
Ft. gargarisma.
Sig. Use as a gargle, as directed.
M. B.

℞.
Acid. nitrohydrochlor. dil., fʒiij;
Ext. chiratæ fld., fʒj;
Ext. tarax. fld., q. s. ft. fʒiv.
Misce.
Sig. A tea-spoonful before meals.
G. O. M.

Ethereal Liquids made by Percolation or Maceration.

Oleoresinæ (Oleoresins).—Oleoresins are liquid preparations made by extracting from certain vegetable substances the natural oils and resins contained therein by means of percolation with ether. They are much more concentrated preparations than fluid extracts, and do not bear any fixed and definite relation to the drugs from which they are prepared, as do the fluid extracts; moreover, they do not contain exactly the same constituents as fluid extracts of the same drugs, since alcohol and ether possess different solvent powers, many substances soluble in one being insoluble in the other. They should be entirely free from the odor of ether or benzin, this latter substance being sometimes substituted for ether in making these preparations—a proceeding which is entirely unjustifiable.

Owing to the powerful and disagreeable taste and odor of the oleoresins, they are usually given enclosed in capsules of gelatin, in pills, or emulsified, so as to obtund the taste, as the prescriptions given below indicate.

The official oleo-resins are those of aspidium, capsicum, cubeb, ginger, lupulin, and pepper.

℞.
Oleoresinæ cubebæ, ♏xij.
Ft. capsulæ No. iv.
Sig. One, twice a day.
X.

℞.
Oleores. capsici, ♏x;
Linim. saponis, fʒiv.
Sig. Apply at night, as directed.
Q. E. D.

℞.
Ol. terebinth.,
Oleores. aspidii, āā. fʒj;
Sodii chlorid., gr.xv;
Pulv. acaciæ, q.s.
Aquæ, q. s. ft. fʒij.
M. ft.
Sig. Two tea-spoonfuls taken fasting.
W.

℞.
Copaibæ,
Oleores. cubebæ, āā. fʒij.
M. Ft. capsulæ molles No. xx.
Sig. One, 3 times a day.
V. R.

℞.
Morph. acet.,
Oleores. capsici, *āā.* gr. j ;
Pulv. camphoræ,
Ext. hyoscyami, *āā.* gr. xx.
Ft. massa et div. in pil. No. xx.
Sig. One, at night. W. R. T.

Solids.

Preparations made by Percolation or Maceration.

Extracta (Extracts).—Extracts of the Pharmacopœia are solid or semisolid preparations, prepared by extracting the soluble principles of drugs and evaporating the solutions to a proper consistence ; these solutions are prepared either by expressing the juice from the fresh plant or by extracting the soluble principles of the dried drug by means of a solvent. Most of the extracts are directed to be prepared by percolation, and the solutions thus obtained evaporated to the proper consistence by means of a water-bath. They are valuable preparations, affording the means of administering various medicines in pilular form, and when properly made preserving for a long time their virtues unimpaired. They are usually prepared either of such soft consistence as to be readily made into pills, or are reduced to dryness, so that they can be powdered. Thus, aqueous extract of aloes is a dry extract, and extract of colocynth is directed to be in powder. Some of the soft extracts are evaporated until brought to pilular consistence, such as extract of gentian or extract of rhubarb, while others contain 5 per cent. of glycerin, which makes them retain their consistence, preventing them from getting hard—such as, for example, alcoholic extract of belladonna or extract of cinchona ; the extract of malt is evaporated to the consistence of thick honey. Many of the powdered extracts found in the market, although purporting to be of full official strength, are very deficient, being either made of inferior drugs, improperly made, or damaged by heat in the process of drying.

The following is a list of official extracts, in addition to those named above : extracts of aconite, arnica-root, Indian cannabis, colchicum-root, digitalis, ergot, euonymus, glycyrrhiza, hæmatoxylon, iris, juglans, krameria, leptandra, mezereum, nux vomica, opium, physostigma, podophyllum, quassia, stramonium, taraxacum, the alcoholic extracts of conium and digitalis, the compound extract of colocynth, and pure extract of glycyrrhiza.

Formulæ illustrating the methods of prescribing extracts are appended :

℞.
Hydrarg. chlor. mit., gr. xij;
Pulv. ext. coloc. co., gr. xxiv;
Ext. hyoscyam., gr. xviij.
Ft. massa et div. in pil. No. xij.
Sig. One, at night.

℞.
Ferri redact., gr. xx;
Ext. nuc. vom., gr. iv;
Ext. quassiæ, gr. xvj;
Pulv. sapon., gr. viij.
Ft. massa et div. in pil. No. xij.
Sig. One, after meals. V. Q.

℞.
Ext. belladon., gr. vj;
Ext. cannab. Ind., gr. viij;
Ext. ergotæ, gr. l.
Ft. massa et div. in pil. No. xvj.
Sig. One or two during the day as directed. R.

℞.
Ext. aloes, gr. vij;
Ol. carui, gtt. j;
Ext. gentianæ, gr. viij.
Ft. massa et div. in pil. No. vj.
Sig. Two, at night. V. W.

Abstracta (Abstracts).—Abstracts were introduced into the Pharmacopœia of 1880, and were designed with the view of taking the place of various powdered extracts that were found in the market, and which, as prepared by the different manufacturers, varied very greatly in composition and strength. These differences arose from different makers using different menstrua to exhaust the drugs, and in many cases were caused by using too great heat in their preparation during the process of drying.

Another objection to powdered extracts lies in the fact that many of them are slightly hygroscopic, and in consequence after being kept a short time they run together and become hard and tough masses which are very unmanageable.

Abstracts possess certain advantages over both extracts and fluid extracts: they are made of definite strength, 2 parts of drug being represented by 1 part of abstract, being double the strength of fluid extracts. In preparing an abstract the drug is thoroughly exhausted of soluble principles by alcohol; the tincture thus obtained, after being mixed with a portion of sugar of milk, is evaporated spontaneously at a low temperature until it becomes dry; it is then mixed with a sufficient quantity of sugar of milk to make the product weigh one-half the weight of the drug used, and reduced to a uniform fine powder. The drug is thus presented in a soluble condition, and, not being subjected to a temperature at any time exceeding 158° F., it is not injured by heat. They are permanent preparations, are very portable, and will retain their pulverulent condition indefinitely if proper precautions are taken to protect them from moist air; they should be kept in a cool place. They contain no alcohol, and can be conveniently administered

in capsules. Their definite relation to the drugs from which they are prepared is of importance and value to the physician in fixing the dose, which is just one-half that of the drug itself or of its fluid extract, while the dose of solid extracts bears no such relation to the drug and varies with each preparation.

The following abstracts are official: viz. abstracts of aconite, belladonna, conium, digitalis, hyoscyamus, ignatia, jalap, nux vomica, podophyllum, senega, and valerian.

Illustrations are appended showing the manner of prescribing abstracts. They may be administered in powders, cachets, pills, capsules, or in solution or mixtures:

℞.
Abstract. aconiti,
Pulv. sacch. lact., *āā.* gr. vj.
M. Ft. chart. No. xij.
Sig. One every 3 hours.
M.

℞. For Willie ——.
Abstract. jalapæ, gr. xv;
Hydrarg. chlor. mit.,
Pulv. aromat., *āā.* gr. v;
Pulv. sacch. lact., gr. xxx.
Fiant chart. No. xv.
Sig. One every fourth hour.
X.

℞.
Abs. belladonnæ,
Res. podophylli, *āā.* gr. vj;
Pulv. capsici, gr. xij.
M. Fiant pil. No. xxiv.
Sig. One pill at night.
H.

℞.
Abstract. nucis vom., gr. xij;
Zinci phosphid., gr. j.
Fiant capsulæ No. xij.
Sig. One, 3 times a day.
Z.

Resinæ (Resins).—The resins of the Pharmacopœia are solid preparations, consisting principally of the resinous principles either of natural oleoresins obtained as residues after distilling off their volatile oils, or of vegetable substances prepared by precipitating with water their alcoholic tinctures.

They differ from alcoholic extracts in containing only those principles which are soluble in alcohol, but insoluble in water, while alcoholic extracts contain all the principles that are soluble in alcohol.

There are five resins official: resin, the residue obtained by distilling off the volatile oil from turpentine; resin of copaiba, the residue after distilling off the volatile oil from copaiba; and the resins of jalap, podophyllum, and scammony, made by percolating the respective drugs with alcohol and precipitating the resin by the addition of water.

Resin of podophyllum is much the most important of this group of preparations: the official resins, with the exception of resin of copaiba, are hard solids, or, as usually found in pharmacy, reduced to fine

powder. Resins are nearly always prescribed in combination with other ingredients; as, for example, in the following prescriptions:

℞.

Res. podophyll.,	gr. iij;
Pulv. capsici,	gr. vj;
Ext. belladon.,	gr. ss;
Pulv. sacch. lact.,	gr. xij.

M. Ft. pil. No. xij.
Sig. One at night.
N. S.

℞.

Res. scammon.,	gr. xij;
Pulv. aloes,	gr. xv;
Ext. colocynth.,	gr. iij;
Potass. sulph.,	gr. ij;
Ol. caryoph.,	gtt. j.

M. Ft. pil. No. xij.
Sig. One or two as directed.
V. T.

Extemporaneous Preparations.

Pulveres (Powders).—Powders form a convenient method of administering many medicines, such as are not deliquescent or are not particularly offensive to the taste, and of which the doses are small.

The powders of the Pharmacopœia are all compound; that is, each one consists of two or more substances mixed together. Although volatile or deliquescent substances are not suitable for powders, it sometimes becomes necessary to prescribe them in this form; in such cases the powders should be dispensed wrapped in papers coated with wax or paraffin to protect them from the air, and if required to be kept for any length of time they should be preserved in closely-stopped bottles.

The following powders are official: viz. antimonial, aromatic, compound chalk, and compound effervescing powders, powder of ipecac and opium, and compound powders of glycyrrhiza, jalap, morphine, and rhubarb.

Powders are well suited for administration to infants and children if the ingredients are not repulsive or disagreeable to the taste. In prescriptions in which it is the intention to divide the powders into convenient doses and dispense them folded in small papers, they are distinguished by the name "chartulæ."

The following are given as illustrations of the methods of prescribing powders:

℞.

Bismuthi subnit.,	gr. xij;
Pepsini,	gr. vj;
Pulv. sacch. lact.,	gr. xij.

M. Ft. pulv. et div. in chart. No. xij.
Sig. One every 3 hours. V. N.

℞.

Hydrarg. chlor. mit.,	gr. iij;
Pulv. sacch. alb.,	gr. xij.

M. Ft. pulv. et div. in chart. No. xij.
Sig. One, 3 times a day. M.

℞. For Elsie ——.

Quinin. sulph., gr. vj;
Sod. bicarb., gr. j;
Pulv. ext. glycyrrh.,
Pulv. sacch. alb., āā. gr. vj.
M. Ft. pulv. et div. in chart. No. xij.

Sig. One powder in a half-teaspoonful of syrup.

E. A. S. Y.

℞.

Abstract. bellad., gr. iij;
Pulv. opii, gr. vj;
Pulv. aromat., gr. iv;
Pulv. sacch. lact., gr. xij.
M. Ft. pulv. et div. in chart. No. xij.

Sig. One powder every 4 hours, as directed.

L.

Triturationes (Triturations).—This title has been adopted by the Pharmacopœia to signify powders prepared by triturating 1 part of a medicinal substance with 9 parts of sugar of milk. While a general formula for their preparation is given, there is only one trituration official, that of elaterin, and it furnishes a convenient form for administering this powerful remedy; but it is doubtful whether such an official preparation is desirable, and perhaps it would be better to leave such mixtures to extemporaneous prescription.

In prescription it would be desirable to combine the trituration with an aromatic to prevent griping.

℞.

Trit. elaterini, gr. vj;
Pulv. aromat.,
Pulv. sacch. alb., āā. gr. xij.
Ft. pulv. et. div. in chart. No. xij.

Sig. One, as directed.

V. W.

℞.

Trit. elaterini, gr. vj;
Oleores. capsici, gtt. j;
Pulv. micæ panis, gr. xij.
Ft. pulv. et div. in cachet No. xij.

Sig. One, as directed.

L. N.

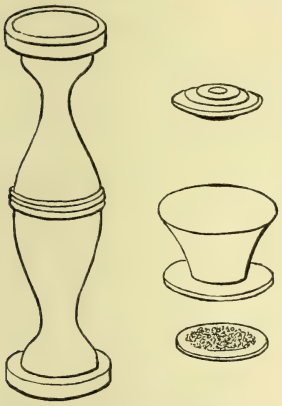
Wafers or Cachets (Cachet de Pain).—Wafers are prepared by pouring a thick, smooth mixture of flour and water between greased hot polished plates or cylinders, so adjusted that a thin sheet or wafer is produced; by the rapid evaporation of the water the wafer becomes spongy in its character. When dry it is hard and brittle, but when moistened it becomes soft, tough, and slippery, and is well adapted for taking medicines in the form of powder. A powder may be conveniently administered by placing it upon a piece of moistened wafer laid upon a table-spoon, and folding the corners so as to cover it completely, when with the aid of a little water it can very readily be swallowed.

The cachet, or as sometimes called "cachet de pain," consists of two concave pieces of wafer, varying in size from $\frac{3}{4}$ inch to $1\frac{1}{8}$ inches in diameter, round or oblong in shape, in one of which the powder to

be administered is placed, and the other, having previously been moistened, is then laid over the powder and the two margins are pressed together, when they adhere and completely enclose the powder.

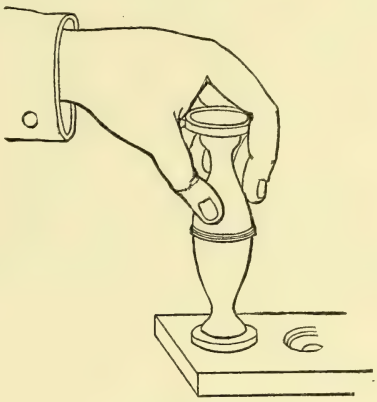
The apparatus used for preparing "cachets" is shown in Figs. 10, 11, and 12. In Fig. 10 the lower cachet, filled with powder, is seen,

Fig. 10.



Cachet-wetter and Funnel.

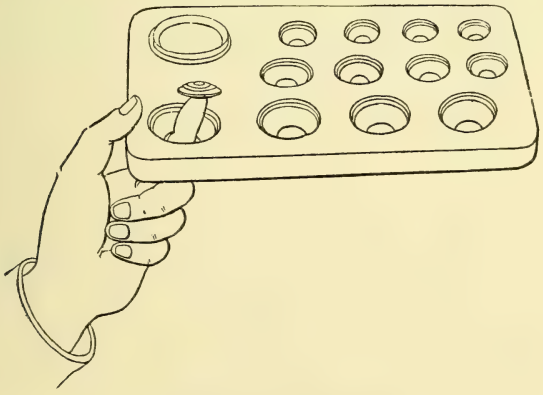
Fig. 11.



Sealing the Cachet.

above it the funnel used for the powder, and above the funnel the sealed cachet ready for use. In Fig. 11 is shown the method of sealing the cachet by pressing the upper cachet with its moistened edge upon the

Fig. 12.



Limousin's Cachet-board.

lower cachet; adhesion takes place, and the sealed cachet is pushed out of its bed in the board, as seen in Fig. 12.

Upon being floated upon a table-spoonful of water or dipped for a few seconds in water the cachet becomes soft and slippery, and, like the wet wafer, can easily be swallowed with a draught of water, the wafer when wet passing into the œsophagus imperceptibly. The advantage

of the cachet over the wafer is that no more of the enveloping material than is necessary to cover the medicine is used, and the dose can therefore be more readily swallowed, because its bulk has been reduced to the minimum.

Cachets furnish a most excellent means of administering nauseous or bitter powders, and when patients have once acquired the knack of swallowing them easily, they become very much pleased with this mode of taking medicine. Care must always be taken to explain in detail to the patient (in case the latter should not be familiar with cachets) their mode of administration, or ludicrous *faux pas* are likely to occur, such as masticating the dry cachet, or, as one patient observed to her physician on the next visit that he paid her, that she wished he would tell the apothecary not to be so particular next time to seal the medicine up "so tight in the papers," as it took a whole hour of her time to cut each one open with a pair of scissors to get the medicine out. She was very much surprised when her adviser told her that this was one of those cases in which the "papers" so called must be swallowed along with the powder.

"Cachets" may be prescribed in the following manner:

℞.

Quinin. sulph., gr. xxiv;
Ferri redacti, gr. xlviij;
Ft. pulv. et div. in "cachet" No. xxiv.
Sig. One, 3 times a day.

L. M.

℞.

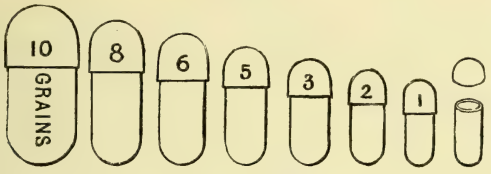
Ol. croton. tig., gtt. iij;
Pulv. micæ panis (siccæ), q. s.
Ft. pulv. et div. in "cachet" No. xij.
Sig. Take two, as directed.

R.

Capsulæ (Capsules).—Capsules made of gelatin furnish a convenient method for administering nauseous or disagreeable medicines. Several kinds are in use—*hard* and *soft* capsules, which contain liquids, and *empty* capsules (cylindrical), for holding solids. Pearls are globular in shape, and differ from capsules in being *completely* filled with liquid; they thus have the advantage of being smaller in size. Ordinarily, capsules are ovoid in shape, and are prepared from a dense, hot solution of gelatin by dipping a greased bone or ivory mould into the solution, allowing the film to remain long enough to be sufficiently dry to handle, when it is dexterously pulled off; the empty capsule is then held upright and filled with the liquid medicine, and sealed by dropping some hot gelatin solution on the opening. A small air-space is left inside the capsule by this method of filling. The capsule upon drying becomes hard, and is impervious to the various medicines that can be administered in this form. The addition of glycerin to the solution of gelatin renders the capsule permanently soft. Empty

capsules are cylindrical in shape, with rounded ends, and are made in two pieces, one of which is of slightly larger diameter and fits closely over the other. The medicinal ingredient in the form of powder or pill mass is placed in the smaller cylinder, and the shorter cylinder is pressed down over it like a cap. When a liquid is used, if the edge of the lower cylinder is slightly moistened with water, it may be made

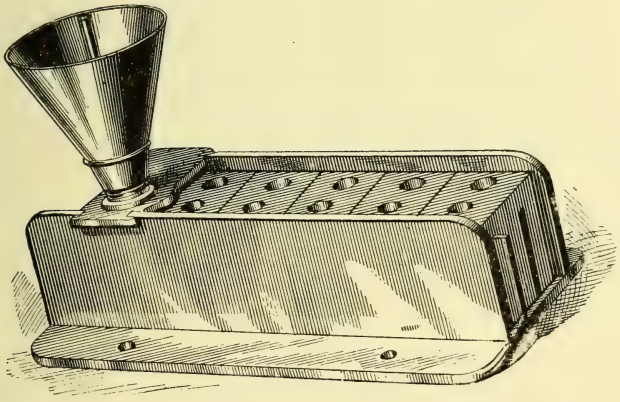
Fig. 13.



Empty Capsules.

to adhere closely to the upper piece and form a perfect joint, thus preventing leakage. Empty capsules are shown in Fig. 13, arranged

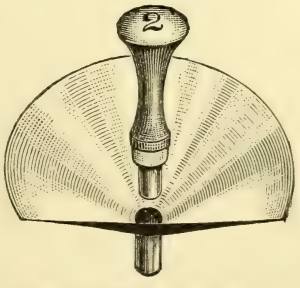
Fig. 14.



Acme Capsule-filler.

according to their respective sizes. Owing to their extended employment, they are now manufactured on an enormous scale. For filling empty capsules several machines have been invented. The "Acme" (Fig. 14) is very ingenious and simple. A block of wood holding twelve capsules is pushed into a nickel-plated metal frame which bears an inclined plane set on edge. The empty capsules having been placed in the holes, the first capsule is run under the funnel and filled; then the block is pushed to the right and No. 2 is filled, and so on until the six on the side are filled. As they are

Fig. 15.



Davenport's Capsule-filler.

pushed along they are raised out of their beds by the inclined plane, when they may be easily capped. Davenport's capsule-filler (Fig. 15) is very simple, and when small quantities are needed it answers very well. The mouth of the funnel is inserted into the capsule, and the powder, having been introduced into the funnel, is "rammed" into the capsule with the plunger. The cap is then put on, and all is complete.

The following prescriptions illustrate methods of directing medicines to be dispensed in capsules:

℞.
Ol. picis liq., ʒj.
In capsulis div. No. xij.
Sig. One, 3 times a day.
W. B.

℞.
Quinin. sulph., gr. xxiv;
Ext. nucis vomicæ, gr. xij;
Acid. arsenios, gr. j.
Ft. capsul. No. xxiv.
Sig. One, twice a day.
V. R.

℞.
Antifebrin., ʒij.
In capsulis div. No. xxx.
Sig. One or two capsules every half-hour.
D. B.

Tabellæ (Tablet-triturates).—Tablet-triturates are small disk-shaped bodies prepared by moistening medicated powders with a highly volatile liquid, then moulding the moistened powder, ejecting the tablet, and allowing the liquid to evaporate, when the tablets retain their shape. The basis of tablet-triturates is mostly finely-powdered sugar. They were first suggested by Dr. Robert M. Fuller in 1878, and are now largely employed. They possess advantages over any other method of administering solid substances, such as powders, pills, or capsules. They are much more readily and conveniently taken, and possess all the solubility of powders, which perhaps are the most inconvenient and disagreeable form of administering medicines. Capsules are more convenient than powders, but have the disadvantage of being less soluble, while pills are sometimes so insoluble as to pass through the alimentary canal without disintegration. Well-made tablet-triturates will disintegrate immediately.

The apparatus for making these tablets consists of two plates of metal, hard rubber, or other suitable material, one of them being perforated with holes having the size of the required tablets, the other having pegs upon it so situated that (when in position) these shall exactly fit into the holes in the perforated plate. The pegs must be longer than the thickness of the perforated plate, and at each end of the plate is a longer and larger peg, which, fitting into a corresponding

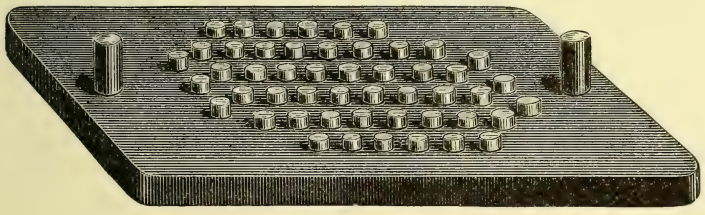
hole in the perforated plate, serves as a guide and secures the proper position of the plates when used.

In making tablets the medicated powder is made into a paste by moistening it with alcohol or other suitable liquid, and pressed with a spatula into the holes of the perforated plate (Fig. 16) which has previously been laid upon a pill-tile or glass plate. When the holes are

Fig. 16.



Fig. 17.



Tablet Machine.

filled, the excess of paste is cleaned off and the plate is placed over the one having the pegs (Fig. 17), and so adjusted that the larger pegs shall enter the corresponding holes in the perforated plate, which latter plate is then pressed gently down until the plates are brought into contact, and each of the smaller pegs, pushing out the paste from its corresponding hole, will have a tablet resting upon it. The plate is then set aside until the liquid has evaporated and the tablets are sufficiently dried to be removed; this requires but two or three minutes, when, after being thoroughly dried, they are ready for use. Tablets for hypodermic applications may be conveniently prepared by this process, care being taken that the ingredients are thoroughly mixed and that the quantities in each tablet are accurately proportioned.

Tablets are made by this process from powdered sugar of milk, powdered sugar, and a small quantity of acacia, without medication; these have been called blank tablets. They are used by adding the proper amount of medicated material in solution, such as an alcoholic fluid extract, and allowing the liquid to evaporate. When dried they are called tablet-saturates.

Following are given prescriptions for tablet-triturates and tablet-saturates:

℞.
Hyoscyaminæ pur., gr. $\frac{1}{60}$.
Ft. tabella trituratio.
Mitte tales xx.
Sig. One at night. W. W.

℞.
Acid. arseniosi, gr. $\frac{1}{100}$.
Ft. tabella trituratio.
Mitte tales xl.
Sig. Two, 3 times a day. N. L.

℞.
Ext. aconit. fld., ♏j.
Ft. tabella saturatio.
Mitte tales x.
Sig. Take one, every 4 hours.
A. K.

℞.
Ex. digital. fld., ♏j.
Ft. tabella saturatio.
Mitte tales xij.
Sig. Take two, every 3 hours.
W. C.

Trochisci (Troches).—Troches or lozenges are small, solid masses, generally of cylindrical or flattened shape; they are intended to be dissolved in the mouth slowly and gradually, and furnish a pleasant and convenient means of administering many remedies. Only such medicines as are used in small doses, and which have no particularly disagreeable taste, can be appropriately given in this form. Lozenges are made by beating the basis containing the medicinal agent, which is usually finely-powdered white sugar, known technically as "lozenge sugar," with sufficient mucilage of tragacanth to form a soft mass. This is rolled out on a board with a rolling-pin into a flat, smooth cake, and when of the proper thickness it is cut with a lozenge-punch or cutter. (See Figs. 18 and 19.) There are sixteen official formulas for troches, as follows: troches of bicarbonate of sodium, catechu, chalk, chlorate of potassium, chloride of ammonium, cubeb, ginger, glycyrrhiza and opium, ipecac, iron, krameria, magnesia, morphine and ipecac, peppermint, santoninate of sodium, and tannic acid. Morell Mackenzie has introduced many formulæ for lozenges for throat affections which have for their basis currant-fruit paste; these have been largely used. Physicians may usually have lozenges made for them extemporaneously if the pharmacist is given an hour or two for their preparation; they require a short time to dry properly.

Fig. 18.

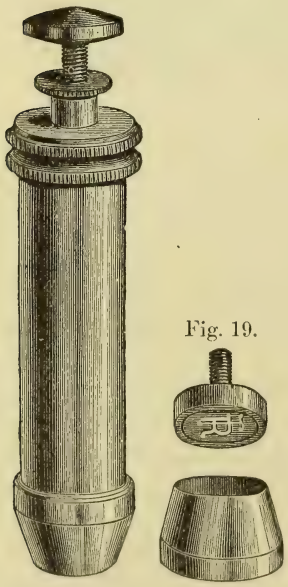


Fig. 19.

Lozenge-cutter, with Die.

Bacilli are cylindrical lozenges made by cutting the lozenge mass, rolled into a soft cylinder, on a pill-machine; the well-known Wistar's and licorice lozenges of the manufacturers closely resemble bacilli.

The following are formulas for troches:

℞.

Res. guaiaci,	gr. lxx;
Pulv. tragacanth.,	gr. vij;
Pulv. sacch. alb.,	gr. xxx;
Gelationis ribis rub.,	q. s.

Fiant troch. No. xxxv.

Sig. One lozenge every 2 hours.

V. K.

℞.

Bismuth. subnit.,	ʒij;
Cretæ præparat.,	ʒiv;
Ol. caryoph.,	gtt. j;
Ol. cinnam. zeylan.,	gtt. j;
Pulv. sacch. alb.,	
Muc. tragacanth.,	āā. q. s.

Fiant troch. No. xl.

Sig. One lozenge, 4 times a day.

R. T.

Confectiones (Confections).—Confections are soft solids made by incorporating medicinal substances with saccharine matter, with the object of furnishing an agreeable and convenient mode of administration. Only two confections are official: confection of rose and confection of senna. Confection of rose is almost exclusively used as a vehicle for other medicines, but is also used as an excipient in making pills, to give proper consistence to the mass. Confection of senna is an agreeable and efficient laxative. Both of these confections are elegant preparations when properly made, and keep well when carefully secured.

℞.

Sulphur. sub.,	ʒj;
Conf. sennæ,	ʒiij.
M.	

Sig. A tea-spoonful at night.

V. N.

℞.

Pulv. antimonial.,	gr. ix;
Pulv. res. guaiac.,	gr. xij;
Pulv. aloes. pur.,	gr. ix;
Pulv. myrrh.,	gr. vj.
Conf. rosæ,	q. s.

Ft. massa et div. in pil. No. xij.

Sig. One, 3 times a day.

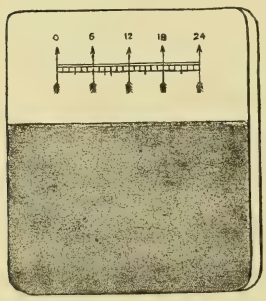
K. K.

Pilulæ (Pills).—Pills are globular or spherical solid bodies of such size that they may be conveniently swallowed; their weight varies from a grain or less to five or six grains when made of ordinary vegetable drugs, and to eight or ten grains when made of heavy mineral substances. The method of administration of medicines in pilular form is a very popular one, pills being cheap, compact, portable, convenient, and by the great majority of persons easily taken. Such medicines as are nauseous or disagreeable to the taste, and of which the dose is small, are conveniently given in this form. Pill-masses, while being sufficiently soft and plastic to be made into pill form, must be hard enough to retain their shape when thus made. Liquids or soft substances can be made into pilular form by the addition of dry inert powders, while hard substances, such as gum-resins, extracts, etc., require the addition

of a small quantity of water or of alcohol, and powders or substances which are wanting in adhesive qualities can be rendered sufficiently adhesive by the addition of mucilage, glycerin, glucose, syrup, or other viscid or tenacious liquid. A judicious selection of excipients to give the proper consistence to articles used in making pills requires good judgment, a practical knowledge of the physical properties and peculiarities of the various substances prescribed, and practical experience. One of the best excipients for general use consists of a mucilage made by gently heating a mixture of 1 part of tragacanth and 8 parts of glycerin until a uniform jelly is produced.

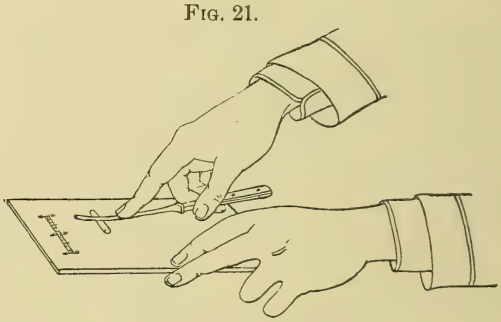
When the pill-mass has been properly made, it is rolled into a cylinder upon the pill-tile (Fig. 20), the best form of tile being that shown in Fig. 21, which is made of plate-glass, having the greater

FIG. 20.



Pill-tile.

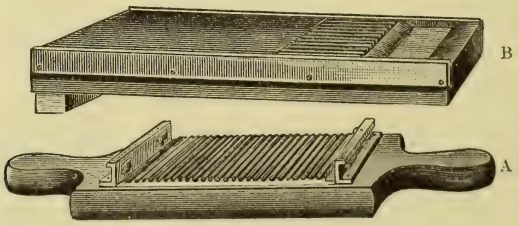
FIG. 21.



Rolling a Pill-cylinder.

portion roughened, so as to prevent the slipping of the cylinder during rolling. When pills are to be made in larger quantities, it will be found more satisfactory to use a pill-machine. This consists of two walnut boards, A, B, as shown in Fig. 22 and Fig. 23. These have

FIGS. 22, 23.



Pill-machine.

plates made of brass, with grooves in them. The pill-cylinder is laid across the grooves in B, and when A is pressed down upon it the pill-cylinder will be cut into pieces, which may then be rolled into pills.

With the view of covering their taste, as well as of rendering them more sightly, pills are covered with various substances, such as sugar,

gelatin, tolu, gold-leaf, silver-leaf, etc. The coating with sugar is usually done by machinery, and pills thus coated are made in immense quantities. Processes suitable for the retail pharmacist for coating pills with sugar on the small scale are not satisfactory, while coating with gelatin, tolu, and gold- or silver-leaf can be readily and quickly performed.

The advantages of coated pills are: they are more sightly; their disagreeable taste is concealed; they are protected from the air, and therefore keep better, being less liable to undergo change; and they retain their shape better. On the other hand, they have the disadvantage of being slower in their action in consequence of being less soluble, and sometimes their activity is greatly impaired by the use of too much heat in drying the pills preparatory to the process of coating.

Compressed pills are now very largely used; they are made by compressing dry powders into moulds by suitable machines, the force applied being sufficient to make them cohere. The advantages of this form of pill are, that, having no foreign substances or excipients mixed with the medicines employed, they are more easily and quickly dissolved in the stomach, they are handsome in appearance, and usually are more easily swallowed than ordinary pills.

Machines for making compressed pills are manufactured to be operated either by hand or steam-power, and are so arranged that pills of any size, from official troches or lozenges to hypodermic tablets, can be made very rapidly.

The following prescriptions illustrate various combinations used in prescribing pills:

℞.

Aloe purif., gr. xij;
Mass. hydrarg., gr. vj;
Res. podoph., gr. iss.
M. Ft. pil. No. vj.

Sig. One or two at night.

E. V. W.

℞.

Ferri sulph., gr. xxiv;
Potass. carb., gr. xvj;
Pulv. sacch. alb., gr. vj;
Glyc. tragacanth., q. s.
Ft. pil. No. xij.

Sig. One, 3 times a day. W. M.

℞.

Pulv. opii,
Ammon. carb., *āā*. gr. x;
Pulv. camphoræ, gr. xx.
M. Ft. pil. compressæ No. x.

Sig. One at night.

M. A.

℞.

Morph. sulph., gr. iij;
Ext. colch. acet., gr. xx;
Res. podoph., gr. ij.
Ft. massa et div. in pil. No. xij, et cum saccharo tege.

Sig. One at night. L. W.

℞.

Aloini,	gr. vj ;
Strychninæ,	gr. ss ;
Ext. belladon.,	gr. iv.

Ft. massa et div. in pil. No. xxx.

Sig. One, twice a day.

C. L. B.

℞.

Ferri valer.,	gr. iij ;
Zinci valer.,	gr. xxiv ;
Ext. sumbul.,	gr. vj.

Ft. massa et div. in pil. No. xij, et fol. argenteo involve.

Sig. One, 3 times a day.

L. E. T.

Cerata (Cerates).—Cerates are unctuous preparations consisting of wax, mixed with oils, fatty substances, or resins, and of such consistence that at ordinary temperatures they can be readily spread upon linen or muslin, and yet so firm that they will not melt or run when applied to the skin. In this respect they differ from ointments, which are appropriately used for inunction, and become liquefied by the heat of the body when thus applied. The lard, oils, or other fatty substances from which they are prepared should be entirely free from rancidity, and as a general rule the temperature used in making them should not be higher nor continued for a longer time than is necessary to mix the ingredients thoroughly, any decomposition by heat, which would tend to render them irritating, being thereby avoided; and when prepared they should be kept as much secluded from exposure to air as possible. When, however, the virtues of some ingredient are best extracted by heat, or when an excess of liquid is to be evaporated —as, for example, in making cantharides cerate or savine cerate—a greater and more continued heat is required. Cerates prepared with white wax become rancid sooner and more readily than those prepared with yellow wax, and the cerate known as simple cerate would probably be a better preparation if made with yellow wax; but white simple cerate has been popularly known for so long a time that a colored preparation to take its place would not be received with favor.

℞.

Extracti stramonii,	ʒss ;
Cerati,	℥j.

Misce secundum artem.

In compounding a prescription like the foregoing, in which an extract is directed to be mixed with a cerate, the extract should first be rubbed in a warm mortar with a little water or alcohol until reduced to a uniform, soft consistence, and then mixed with a small quantity of the cerate until thoroughly incorporated, after which the remainder of the cerate should be gradually added and the whole rubbed together until a uniform mixture is produced.

Prescriptions are frequently written directing liquids to be mixed

with cerates where the amount of liquid is excessive or greater than can be retained by the cerates; in such cases, after the cerates are saturated, the remainder is usually thrown away. Cerates, being of harder consistence than ointments, will not retain as much fluid, but the amount taken up may be increased by the addition of a small quantity of lard or oil if the softer consistence thus produced is not objectionable.

The following cerates are official: viz. cerate, cerates of camphor, cantharides, extract of cantharides, resin, savine, spermaceti, and subacetate of lead.

Cerates may be prescribed as follows:

℞.

Cerat. cantharid., q. s.
Spread a blister upon adhesive plaster 3 × 7 in.
W. V.

℞.

Liq. plumbi subacet., f℥j;
Cerat. camphoræ, ℥iv.
Misce sec. art.
Sig. Apply to the part night and morning. N. T.

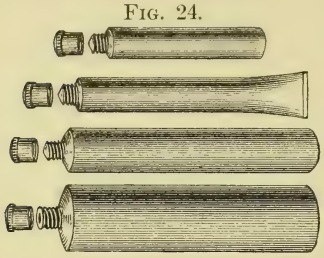
Unguenta (Ointments).—Ointments are unctuous preparations made from oils, lard, petrolatum, or other fatty substances, and of such consistence that when applied to the skin they become liquefied by the heat of the body, thus differing in consistence from cerates. In preparing and preserving ointments the same precautions which were given respecting cerates in regard to heat, rancidity, and exposure to air should be observed. Ointments are prepared either by melting the ingredients together by heat or by incorporating the medicating substance, which is generally insoluble in the fatty matter, by trituration. The mixture may be made with a mortar and pestle, or, if the substance is in fine powder, it may be mixed with the lard or other fat upon an ointment slab by the aid of a spatula; in either case care must be taken to have the ingredients thoroughly mixed and the ointment smooth and uniform. The single exception to these methods is the ointment of nitrate of mercury, in which lard oil and nitrate of mercury are heated together, when a chemical reaction takes place, resulting in the change of the olein of the oil into elaidin, with which the nitrate of mercury is subsequently mixed. In making or dispensing this ointment, as well as those containing tannic or other free acids, an iron spatula should not be used.

The following official ointments are made by fusion: ointment, diachylon, mezereum, and tar ointments, and the ointment of rose-water; while the following are made by incorporation: alkaline sulphur, belladonna, chrysarobin, iodine, iodoform, mercurial, nutgall, stramonium, sulphur, and veratrine ointments, and the ointments of ammoniated mer-

cury, carbolic acid, carbonate of lead, iodide of potassium, oxide of zinc, red oxide of mercury, tannic acid, and yellow oxide of mercury.

Soft ointments may be very satisfactorily dispensed in *collapsible tubes*, like those used for holding artists' oil colors. (See Fig. 24.) The ointment is easily introduced in the large open end of the tube, and this then closed by folding the soft metal sides together; when it is desired to use some of the ointment the screw cap is removed and sufficient is pressed out. The advantages of this mode of dispensing are that the ointment is preserved from change by preventing the access of air, waste is avoided, as well as the greasing and soiling of furniture due to the passage of fatty oils through the ordinary wooden boxes that are often used to dispense ointments in.

FIG. 24.



Lanolin (the purified fat from sheep's wool), petrolatum, cosmoline, and vaseline (purified products from petroleum residues), have all been used as substitutes for lard and animal fats as bases for ointments; but unless otherwise specified, it is always understood that when ointments are prescribed purified lard is the basis.

The following methods of prescribing ointments are given as illustrations:

℞.
Ung. hydrarg. nit., ʒiij;
Ung. aq. rosæ, ʒv.
M. Ft. unguent.
Sig. Apply to the eyelid at night.
N. T.

℞.
Ung. stramonii, gr. xx;
Pulv. gallæ, gr. xxx;
Adipis, ℥ss.
M. Ft. unguent.
Sig. Apply as directed.
W. B.

℞.
Ext. belladon., gr. vj;
Petrolati, ʒiv.
M. Ft. unguent.
Sig. Apply as directed.
L. V.

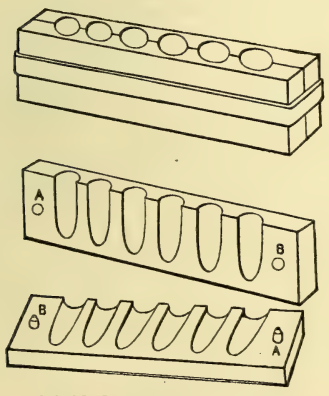
℞.
Hydrarg. ammon., gr. v;
Glycerini, gtt. v;
Adip. benz., ℥ss.
M. Ft. unguent.
Sig. Use as directed.
L. B.

℞.
Veratrinæ, gr. x;
Lanolini, gr. xxx.
M. Ft. unguent.
Sig. Rub on the part as directed.
M. M.

℞.
Ung. acidi gallici, ℥ss;
Ung. zinci oxidi, ℥iss.
M. Ft. unguent.
Sig. Apply night and morning.
D. B.

Suppositoria (Suppositories).—Suppositories may be described as solid medicated compounds designed to be introduced into the rectum, urethra, or vagina, serving the purposes of ordinary clysters or injections, over which they have the advantages of greater comfort and cleanliness, as well as being more easily introduced; their consistence is such that while they retain their shape at ordinary temperatures, they will readily melt at the temperature of the body. The material best adapted for use as the vehicle appears to be the oil of theobroma (butter of cacao), which possesses in an eminent degree both of the above requirements. A mixture of gelatin and glycerin has been successfully used as a vehicle, more particularly for urethral suppositories, butter of cacao being too brittle for convenient use. Glycerin suppositories, containing 95 per cent. of glycerin, are largely used. The size of suppositories has been gradually diminishing; formerly they were made to weigh from one to two drachms or more; in the Pharmacopœia of 1870 they were directed to be made to weigh thirty grains, while in the present Pharmacopœia their weight is directed to be about fifteen grains. In order that suppositories may be uniform in size and shape, they are generally run or pressed into moulds, which in the absence of metallic moulds may be made of sized paper folded into the shape of cones. They may also be made by hand by grating cacao butter with an ordinary grater, and then mixing in the medicinal ingredients in a mortar, adding, if necessary in cold weather, a drop or two of olive oil: the whole is to be made into a mass with a pestle and then rolled out in a cylinder on a pill-tile. The cylinder is then cut into suitable

FIG. 25.



Divided Suppository-mould.

FIG. 26.

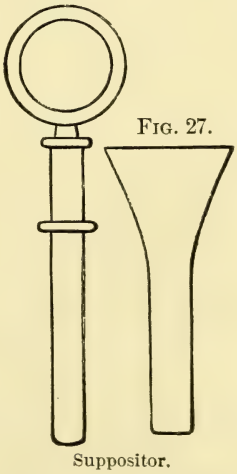


FIG. 27.

Suppositor.

lengths for a suppository, and one of the ends is pointed by pressing it into shape gently with the finger and thumb.

Although no special suppositories are official, a general formula is

given for their preparation, in which the oil of theobroma is directed to be melted and then mixed with the medicinal portion. Fig. 25 shows a mould for making suppositories. It is made of brass, and the parts are held in place by a rubber band. Machines are now in use whereby handsomely finished suppositories are rapidly made by cold compression, the ingredients having previously been thoroughly mixed. Figs. 26 and 27 show a simple apparatus for introducing suppositories into the rectum. Fig. 27 is hollow, with its lower end reduced in diameter, so that the suppository fits snugly when dropped into it. This end is oiled and introduced into the rectum, the piston (Fig. 26) being used to push the suppository into its place.

Some of the modes of prescribing suppositories are as follows. Some allowance should be made for waste in moulding when the quantity of the basis is specified:

℞.
Ext. hyoscyam., gr. iv;
Ol. theobrom., q. s.
Fiat massa et div. in suppositoria No. iv (*āā.* gr. xv).
Sig. One at night. W. L.

℞.
Morph. sulph., gr. ½;
Ol. theobrom., q. s.
Fiat massa et div. in suppos. No. iv (*āā.* gr. xv).
Sig. One at night. T. T.

℞.
Iodoformi, gr. xvj;
Acid. carbolici, gtt. iv;
Ol. theobromæ, q. s.
Ft. massa et div. in suppos. No. viij (*āā.* gr. xv).
Sig. One, 3 times a day. E. M. D.

℞.
Acidi stearici, gr. lxxx;
Sodii carb., gr. xl;
Glycerini, ʒij.
Misce. et fiant suppos. No. xij (*āā.* gr. lxxv).
Sig. One as required. M. L. T.

℞.
Ext. stramonii, gr. xij;
Plumbi acet., gr. xviij;
Creasoti, gtt. vj;
Ol. theobromæ, q. s.
Fiat massa et div. in suppositoria No. xij (*āā.* gr. xv).
Sig. Use as directed. R. T.

℞.
Quininæ sulph., gr. xvj;
Ol. theobrom., q. s.
Fiat massa et div. in suppos. No. iv (*āā.* gr. xv).
Sig. One, twice a day. B. H.

℞.
Ext. opii, gr. vj;
Hydrarg. chlor. mit., gr. xx;
Ol. theobrom., q. s.
Ft. massa et div. in suppos. No. xij.
Sig. One, 3 times a day. W. W.

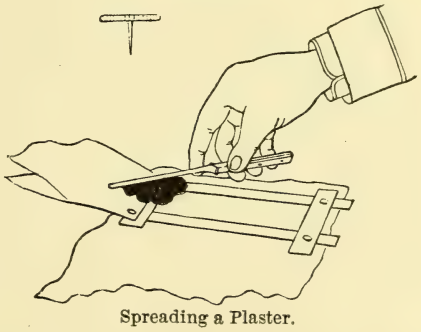
℞.
Ext. ergotæ, ʒij;
Ol. theobromæ, q. s.
Ft. massa et div. in suppos. No. xij (*āā.* gr. xxx).
Sig. One at night. E. M. C.

Emplastra (Plasters).—The word "plaster" is applied both to the material of which plasters are made and to the spread plaster itself. Plasters are intended for external application, and the consistence of the material is such that it requires the aid of heat in spreading it, but is sufficiently soft and adhesive at the temperature of the body to adhere when applied to the skin. There is one exception to this definition of official plasters, and that is isinglass plaster—or court plaster, as it is familiarly called—which is a spread plaster, and does not become adhesive when warmed, but requires to be moistened with water before application.

The most ordinary basis for official plasters is lead plaster, while some owe their adhesiveness and consistence to resinous substances and others to gum-resins. Plasters are usually spread upon leather or muslin, sometimes upon paper. Sheepskin is the kind of skin commonly used; when greater pliability or softness is required buckskin or chamois-skin may be employed. A plaster when spread should be so firm as not to run or melt at the heat of the body, and yet should be soft, pliable, and adhesive. When long kept, plasters become hard and brittle and lose their adhesive properties.

The official plasters have in a great measure been superseded by ready-spread plasters having a rubber basis, which are manufactured of a great variety of kinds and in immense quantities. These plasters are pliable and adhesive, do not change their consistence, and retain their medicinal properties unimpaired for an indefinite length of time. Unfortunately, the process is not adapted to the wants and purposes of the pharmacist, and cannot be used advantageously except upon a very large scale.

FIG. 28.



Spreading a Plaster.

Fig. 28 illustrates the spreading of a plaster. The skin is laid upon a smooth, flat surface of wood and strips of writing-paper are tacked on, as shown, preferably with thumb-tacks. The melted plaster is poured on one end, and it is uniformly spread over the surface with a previously-warmed spatula.

The following list comprises all the official plasters: ammoniac, ammoniac with mercury, arnica, asafetida, belladonna, capsicum, iron, galbanum, mercurial, isinglass, opium, Burgundy pitch, Canada pitch, pitch with cantharides, lead, resin, and soap.

Prescriptions for plasters are usually written in the following forms:

℞.
Emp. belladonnæ.
Spread a breast-plaster 8 inches in diameter. J. S.

℞.
Emp. pic. burg., 4×6.
Dust upon the surface sufficient powdered opium to adhere.
W. L. G.

℞.
Emp. capsici. 4×6.
Sig. Apply upon back, as directed.
K. T.

℞.
Spread a soap-plaster 2×8 inches, with a half-inch margin. D. D.

Chartæ (Papers).—"Papers" of the Pharmacopœia are preparations intended chiefly for external application, and consist of paper saturated or coated with medicinal substances. Only three "papers" are official: cantharides paper, mustard paper, and nitrate-of-potassium paper; the last, in addition to being used externally in the shape of moxas, is much used in cases of asthma. It is sometimes called asthma-paper, and frequently affords relief. It is used by burning the paper and inhaling the fumes while burning.

Chartæ may be ordered in the following manner:

℞.
Chartæ sinapis., j.
3×4.
Sig. Apply immediately. W. V.

℞.
Chartæ cantharidis, j.
For the left ear, as per pattern.
Sig. Apply at once. E. S.

Incompatibility.

Incompatibility is that condition in medicines which results from the admixture of ingredients which are unsuited to each other. It is obvious that incompatibility may arise from a great variety of causes; and it would be impossible to enumerate all of the cases of incompatibility which are likely to occur in compounding medicines; indeed, it is impossible to give even a fair approximation of them. It must not be assumed that incompatibility is always unintentional: the decomposition of a chemical salt is sometimes the object sought by the prescriber. Nothing but a thorough knowledge of the physical and chemical properties of all of the substances which enter into the Materia Medica would absolutely prevent the prescribing of incompatible substances.

In order to grasp more clearly the various phases of incompatibility the subject is divided into three classes: 1. Chemical incompatibility; 2. Physical incompatibility; 3. Therapeutic incompatibility.

1. **Chemical Incompatibility.**—By this is meant the incompatibility which is due to chemical action, which results in decomposition of one or more of the ingredients of the prescription. This form of incompatibility is very common, and may be produced as follows:

1. *Through the precipitation of an insoluble salt by the addition of one solution or salt to another.*

2. *By the decomposition of a salt in solution containing a base united with a weak or volatile acid by the addition of a stronger acid.*

3. *Through the decomposition of a salt in solution containing an acid united with a weak or volatile base by the addition of a strong alkali.*

4. *By the precipitation of alkaloidal salts by the addition to their solutions of alkalies, alkaline salts, or salts which produce insoluble compounds.*

5. *By the unsightly discoloration or precipitation due to the formation of inky compounds, produced by bringing astringent solutions containing tannin or similar substances in contact with ferric salts.*

6. *By the decomposition of a substance without precipitation, because of the formation of products which are soluble in the resulting liquid.*

7. *By the decomposition of a salt in solutions containing a base united with a weak or volatile acid by the addition of a salt containing a stronger acid.*

8. *By the decomposition of an oxidizing agent through the addition of organic or readily oxidizable substances, or by the destructive decomposition of some of the ingredients, with the formation of gases, resulting from the explosive action of the substances entering into the prescription.*

9. *By chemical action in the prescription, which results in an unexpected change in the color of the liquid.*

1. Through the precipitation of an insoluble salt by the addition of one solution or salt to another.

This is one of the most frequent forms of incompatibility. As before stated, some prescriptions are purposely constructed to yield precipitates; injections used in gonorrhœa are often so constructed (See Fig. 29). In this case the precipitated lead sulphate is the important factor. In prescription Fig. 30 a good illustration is afforded of this kind of incompatibility. Sulphate of quinine forms with soluble acetates the insoluble quinine acetate; it is very doubtful whether any of the quinine acetate would be decomposed in the stomach, and a pharmacist would be justified in calling the attention of the prescriber to the character of the precipitate.

Fig. 29.

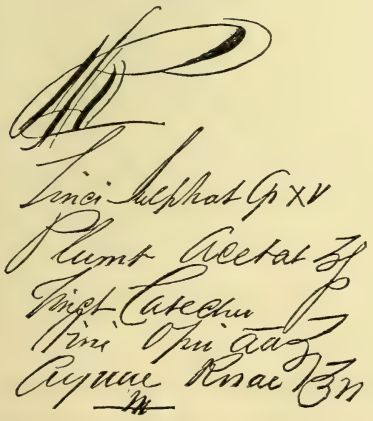


Fig. 30.

℞

Quin. sulph.,	ʒss;
Acid. sulph. dil.,	gtt. xx;
Tinct. card. comp.,	fʒij;
Liq. ammon. acet.,	f ʒiij;
Aquæ, q. s. ad	f ʒiv.

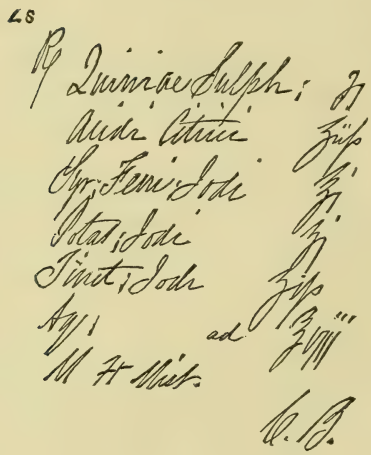
M.

Sig. Take a tea-spoonful 3 times a day.

G. W. N.

In prescription Fig. 31 a complicated reaction occurs. The citric acid is present in sufficient quantity to dissolve the quinine sulphate, but the iodides are decomposed, and the result is the formation of insoluble iodide of quinine. The prescription, which is a facsimile, shows other evidence of lack of skill and judgment. The combinations of alkaloids and iodides or bromides should be avoided.

Fig. 31.



R.	Fig. 32.	
Sodii salicylat.,		ʒss ;
Acid. hydrochlor. dil.,		fʒiv ;
Syr. limon.,		fʒss ;
Aquæ, q. s. ft.		fʒij.
Ft. solutio.		
Sig. A tea-spoonful 3 times a day.		
		L. L.

Prescription Fig. 32 shows a common form of this kind of incompatibility. The soluble salicylates are decomposed by acids, and salicylic acid, being almost insoluble in water, is thrown out of solution. The diluted hydrochloric acid should be prescribed separately.

2. By the decomposition of a salt in solution containing a base united with a weak or volatile acid, by the addition of a stronger acid.

R.	Fig. 33.	
Ammon. carb.,		ʒss ;
Tr. opii camph.,		
Syr. scillæ,		āā. fʒij.
Ft. mistura.		
Sig. A tea-spoonful 3 times a day.		
		V. R.

Prescriptions having this fault are very common. In the illustration given (Fig. 33) the fact that syrup of squill contains acetic acid is usually overlooked, and if the pharmacist forgets this and compounds the prescription in the usual way, decomposition takes place in the bottle, the acid acts on the ammonium carbonate, and carbonic acid is liberated in sufficient quantity to burst the bottle. If the escape of gas is allowed to proceed quietly in the mortar before bottling, no harm will probably ensue. But if it is desirable to give an alkali in such a mixture, liquor potassæ, liquor sodæ, or liquor ammoniæ would be much preferable.

3. Through the decomposition of a salt in solution containing an acid united with a weak or volatile base, by the addition of a strong alkali.

This form of incompatibility is not so common as that last considered. It is seen in Fig. 34, which is a form of caustic sometimes

prescribed. When the strong alkalies are brought in contact with the ammonium carbonate, gaseous ammonia is liberated, until the latter is finally entirely dissipated.

Fig. 34.

℞.
Calcis, ʒiv;
Ammon. carb., ʒss;
Potassæ, ʒij.
Ft. pulv.
Sig. Use cautiously, as directed.
M.

4. By the precipitation of alkaloidal salts by the addition to their solutions of alkalies, alkaline salts, or salts which produce insoluble compounds.

This represents one of the most dangerous forms of incompatibility that can occur. It is well known that the alkaloids are the most powerful and toxic of all of the agents used in the Materia Medica. The alkaloids, morphine, strychnine, quinine, etc., in their pure alkaloidal condition are soluble in oils, alcohol, ether, chloroform, benzine, and other similar solvents, and are mostly insoluble in water. As their aqueous solutions are the most useful in medicine, chemists have been compelled from their introduction to "salify" them, as it is termed; by this is meant the addition of the proper molecular portion of acid to convert the alkaloid into a salt; thus from morphine, by the addition of sulphuric, hydrochloric, and acetic acids, the sulphate, muriate, and acetate of morphine are formed. Now, it requires 10,000 parts of cold water to dissolve 1 part of the alkaloid morphine, but only 24 parts of the same liquid to dissolve 1 part of sulphate of morphine or muriate of morphine, and only half of this quantity, or 12 parts of cold water, to dissolve 1 part of acetate of morphine; thus it follows by the laws of chemical action that if an aqueous solution of an alkaloidal salt is brought in contact with free alkali, decomposition takes place; the acid used in salifying the alkaloid combines with the added alkali, and the alkaloid in its pure state is precipitated. If the solution is strong and the alkali in excess, the precipitation is immediate, and would be apt to be noticed at once by the apothecary; but the alkaloids are rarely given internally in strong solution, and the particular danger lies in the fact that the precipitation of a colorless, transparent alkaloid takes place very gradually in the prescription, and without attracting any attention from the patient after it has left the hands of the pharmacist. The patient is likely in such cases to get no effect from the morphine in the first doses of the medicine, but when the last tea-spoonful is swallowed the quantity of morphine, which should have been distributed equally and the proper amount taken with each dose, *is all taken at once*, and death is likely to ensue. Several cases have been reported in which serious results have followed; and whenever such a prescription is received by a pharmacist, it is his duty to place what is known as a "shake-well" label upon the bottle; but as these labels are often disregarded through carelessness of the

patient, it is never safe to trust to such a course, and such prescriptions should never be written.

The soluble bromides and iodides form with many of the alkaloidal salts bromides and iodides which are insoluble, and hence they should never be prescribed together; the taking of the accompanying prescription (Fig. 35) caused the death of a lady some years ago in Great Britain.

Fig. 35.

℞

Strychniæ sulph.,	gr. j;
Potassii bromid.,	ʒvij;
Aquæ, q. s. ft.	fʒviij.

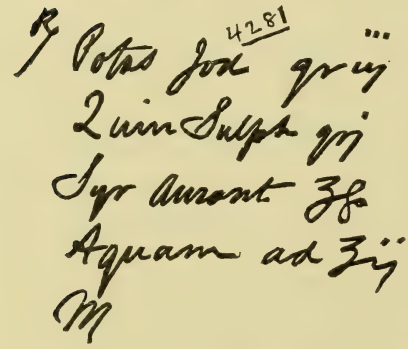
M. Ft. solutio.

Sig. Take a tea-spoonful 3 times a day.

W. R.

For an hour or two after this prescription is prepared there are no signs whatever of decomposition, but after standing for a greater length of time a precipitate of colorless crystals forms in the bottom of the bottle, and in the case above noted the patient took the last tea-spoonful of the mixture with nearly the whole quantity of the strychnine. The pharmacist who compounded the prescription was ignorant of the chemical reaction which took place, or he might have saved her life by directing the mixture to be shaken. Fig. 36 is a facsimile of a one-dose prescription in which the chemical reaction takes place, with the formation of quinine iodide; no danger, however, can occur in the administration of this dose, for none of the ingredients are poisonous in the dose ordered.

Fig. 36.



5. By the unsightly discoloration or precipitation due to the formation of inky compounds, produced by bringing astringent solutions containing tannin or similar substances in contact with ferric salts.

Instances of incompatibility of this class are very frequent; indeed, it is difficult to avoid the formation of inky precipitates, owing to the almost universal presence of tannin in vegetable substances. Fig. 37 illustrates a prescription of this kind. The cinchotannic acid in the cinchona forms an insoluble inky compound with ferric chloride, and the tannate of iron produced communicates a blackish appearance to the mixture which renders it very unsightly.

Fig. 37.

℞

Tinct. ferri chlor.,	fʒij;
Ext. cinchon. fld.,	fʒss;
Syr. tolut.,	fʒiss;
Aquæ, q. s. ft.	fʒiv.

M. Ft. solutio.

A tea-spoonful 3 times a day.

V. T.

Astringent drugs usually owe

their astringency to some form of tannin, and it is therefore safest to avoid combining iron salts with such preparations.

6. By the decomposition of a substance without precipitation, because of the formation of products which are soluble in the resulting liquid.

It must not be supposed that chemical decomposition does not take place when substances are brought in contact, because there is no *outward indication* of a change. Precipitation, it is true, is a common evidence of decomposition, but decomposition may take place with the effect of producing *soluble* compounds, or at least such as are not plainly visible; such a prescription may be seen in Fig. 38. In this case the free alkali will attack the chloral hydrate, decompose it, and produce soluble compounds, some of which are volatile, and the prescription gradually loses its strength.

Fig. 38.

℞

Chloral. hydrat.,	℥ss;
Liq. potassæ,	f℥iv;
Potassii brom.,	ʒij;
Syr. zingib.,	f℥iv.

M.

Sig. A tea-spoonful at night.

W. M.

Alkalies are known to act on some of the alkaloidal drugs injuriously, and it is said that fluid extract of ipecac loses its emetic power if combined with free alkali. Fortunately, this kind of incompatibility is not likely to produce serious effects, as instances of the decomposition-products becoming more poisonous than the original substances are rare.

7. By the decomposition of a salt in solution containing a base united with a weak or volatile acid, by the addition of a salt containing a stronger acid.

This kind of incompatibility resembles very much that treated of in paragraph 2, but on account of the decomposition being produced by a salt instead of an acid, the cause of the difficulty is more liable to escape notice. Two illustrations (Fig. 39 and Fig. 40) are appended, in which explosions occurred, after the mixtures were placed in bottles ready for dispensing. In Fig. 39 the natural acid salts present, or more probably the acidity of the extract of taraxacum (which increases with the age of the extract) was the cause of the explosive action. The course which would be likely to be followed by the pharmacist would be to rub the extract with the liquids until the whole mixture is smooth, and then the solid ingredients would be incorporated gradually, and the mixture dispensed without a suspicion that upon

Fig. 39.

℞

Pulv. rhei,	ʒss;
Magnes. carb.,	ʒij;
Ext. taraxaci,	℥iv;
Tinct. gent. comp.,	f℥ij;
Aquæ,	ad f℥vj.

M. Ft. mistura.

Sig. A tea-spoonful 3 times a day.

L. F. T.

standing the carbonate would be gradually decomposed by the acids present. And when sufficient carbonic acid gas had accumulated the cork would be blown out of the bottle or the bottle itself burst into fragments. If the acidity of the extract be first overcome by neutralizing it with a few drops of any simple alkaline liquid, the difficulty is overcome. In Fig. 40 a very different form is shown. This case calls for special knowledge. Syrup of ferric chloride owes its preservation and effectiveness largely to the presence of an acid salt, together with a slight excess of hydrochloric acid; and when the prescription is allowed to stand tightly corked for a short time, an explosion is certain to occur, owing to the decomposition of the ammonium carbonate and the liberation of carbonic acid. In this case the alkaline salt should not be dispensed in combination.

FIG. 40.

℞
Ext. pulsatillæ fld., gtt xv;
Ext. digital. fld., f℥j;
Liq. potas. arsen., gtt x;
Ammonii carb., ʒij;
Syr. ferri chlorid., ad f℥iv.
Misce.
Sig. Half a tea-spoonful 3 times a day.
N. N.

8. By the decomposition of an oxidizing agent through the addition of organic and readily oxidizable substances, or by the destructive decomposition of some of the ingredients, with the formation of gases resulting from the explosive action of the substances entering into the prescription.

This form of incompatibility occurs frequently, notwithstanding the many warnings that have been issued in the various professional journals, both medical and pharmaceutical. Two substances are responsible for nearly all of the accidents that occur in this way—potassium chlorate and potassium permanganate. They both readily part with their oxygen, and cautious treatment must be the rule if accidents are to be avoided. The safest course is to establish the habit of prescribing all such substances by themselves, without attempting combinations, except those of a very simple character. Fig. 41 exhibits one of these prescriptions. It exploded, notwithstanding the fact that great caution was observed in mixing the ingredients.

FIG. 41.

℞
Calcii hypophos.,
Potassii chlor., āā. ʒss.
M. Ft. pulv. No. vj.
Sig. One to be taken 3 times a day.
V. Q. L.

The hypophosphites, even in solution, have been known to explode violently, and in one case a workman in a large chemical laboratory was killed from an explosion resulting from the evaporation of a concentrated hypophosphite solution, and the cause for it has never been satisfactorily explained. But when two bodies known to evolve large quantities of gas under the influence of chemical action, like the two in the above prescription, are ordered, it is proper for the pharmacist

promptly to decline to compound the mixture. These substances may be powdered separately, and mixed together cautiously on paper with a spatula, and yet explode simply upon standing. Chlorate of potassium can be mixed with sugar without difficulty by mingling them with a spatula, if they have been dried previously and finely powdered; but care must be taken not to strike such mixtures powerfully with a pestle in a mortar, for the concussion is often sufficient to cause explosions.

Fig. 42.

℞.

Ext. nuc. vom.,	gr. ij ;
Ext. aloes. aq.,	gr. xij ;
Potas. permang.,	gr. xij.

M. Ft. pil. No. xij.
Sig. One, 3 times a day.

B.

Fig. 42 illustrates a prescription for pills which exploded after being compounded.

9. By chemical action in the prescription, which results in an unexpected change in the color of the liquid.

Very frequently chemical action is indicated by a change in the color of a liquid prescription. If this occurs after it has left the apothecary's hands, it is sure to occasion remark, and sometimes alarm, on the part of the patient, who is led to believe that some error in compounding has produced the change in color. Tact and judgment should be used by the physician in accounting for these changes, otherwise the reputation of the pharmacist may suffer from an unjust accusation. Mixtures of guaiac containing spirit of nitrous ether or a trace of nitric acid become blue upon standing a short time. This has led many patients to think that the pharmacist has by mistake introduced some copper into the prescription. A few days' or weeks' exposure to the air will sometimes change the character of a substance, so that a prescription put up with the fresh substance will have a different appearance from one compounded from the same substance a week or a month later. Rhubarb, for instance, contains resinous principles and chrysophanic acid; these are affected by alkalies, the reddish-brown color changing to a deep purple. This may be noticed taking place very gradually in the official compound powder of rhubarb. When the rhubarb, magnesia, and ginger are first mixed together the mixture is of a light fawn color, but on standing a few months, particularly if one of the powders has not been perfectly dry, the color changes to a rose color. This is due to the action of the alkali magnesia upon the resinous principles of the rhubarb. The change in color produced when an alkaline solution is added to a liquid preparation of rhubarb —the infusion, for instance—causing it to become dark red, illustrates the rapid action of the alkali upon these principles. Then, again, the coloring matter in many drugs and preparations is discharged by bleaching agents—chlorine, sunlight, bromine, sulphurous acid, etc. etc. Tincture of iodine may have its color removed

by various methods, as the addition of water of ammonia, carbolic acid, and sodium hyposulphite. Incidentally, it might be mentioned that the attempt to refine the tincture of iodine, by taking away its objectionable feature of staining the skin, results in taking away the iodine itself, for it is no longer present in the free state, and in the case of the addition of ammonia the physician might as well prescribe the external application of a solution of iodate and iodide of ammonium.

It would be impossible in the space allotted to this subject to enumerate all of the possible changes in color that are likely to occur in prescriptions. It may be mentioned, however, that acids brighten the red vegetable colors or give them an orange tint, while alkalies cause them to assume a brown or green color; yellow vegetable colors are darkened or turned brown by the addition of alkalies, acids restoring the yellow color, or having in the first place little or no effect upon the original yellow solution. Green vegetable colors are often changed to yellow with acids, alkalies giving them a yellowish-brown color. Blue and violet vegetable colors are reddened by acids, and either become brown when alkalies are added, or, as in the well-known litmus, become blue again.

It is well to observe the changes in the color of prescriptions due to chemical action, but, as a rule, the medicinal activity of substances is not impaired by the change.

Physical Incompatibility.—By this term is meant the condition that is produced by bringing substances into contact which, through the action of physical forces, are dissociated. It differs from chemical incompatibility by the absence of chemical action, and the evidences of physical incompatibility in liquid prescriptions are mostly shown in the precipitation of some of the principles which were in solution in the original liquids. These principles may be active or inert, and thus physical incompatibility may result in the frustration of the intentions of the prescriber, or it may produce consequences which have no significance whatever. It is on the accurate judgment of the apothecary in such matters that the most dependence must be placed, for he must have sufficient knowledge of the physical properties of the various salts, solutions, and preparations to be able to detect almost instantly the cause of precipitation in a mixture, and apply a remedy which will in no way affect the intention of the prescriber, but at the same time supply the demand for satisfactory pharmaceutical preparations. A good illustration is afforded by Fig. 43, for in this case the valuable portion of the prescription would stick resolutely to the sides of the bottle, and the object of the prescription would be entirely brought to naught, if the apothecary did not come to the rescue and apply one of the simplest rules of his art—namely, the "blending of substances which are diverse into one harmonious whole." The resin of guaiac, which dis-

solved in alcohol forms the tincture, would of course be thrown out of combination when mixed with water and syrup, and the patient would simply take a tea-spoonful of diluted syrup of liquorice. In such a case the addition of a little gum acacia by the apothecary would emulsify the tincture of guaiac and hold all of the ingredients together, so that the patient would get in each tea-spoonful the proper proportion of each ingredient.

FIG. 43.

℞

Tr. guaiaci,	f℥iij ;
Syr. glycyrrhizæ,	f℥iv ;
Aquæ, q. s. ft.	f℥ij.

M.

Sig. A tea-spoonful 3 times a day.

T. S.

Fig. 44 illustrates another form of physical incompatibility. The medicated waters are mostly saturated solutions of volatile oils in water, and peppermint-water is no exception. The quantity of potassium bromide here is sufficient to destroy the affinity existing between the oil and the water, and when the solution of the bromide is effected the oil goes out of solution and the liquid becomes opaque from the drops of separated oil. If the peppermint-water be diluted with an equal bulk of water, no difficulty occurs.

FIG. 44.

℞

Potassii brom.,	℥vj ;
Aq. menth. pip.,	f℥xij.

Ft. solutio.

Sig. Half a tea-spoonful at night.

N. G. K.

FIG. 45.

℞

Tinct. nuc. vomicæ,	f℥ss ;
Tinct. gentianæ comp.,	f℥ij ;
Tinct. cinchon. comp.,	f℥vss.

M.

Sig. A tea-spoonful 3 times a day.

G. W. T.

Fig. 45 shows a form of physical incompatibility in which the separated substance is inert; in such cases it is usual to filter the mixture. Care should always be taken by the dispenser to satisfy himself that the precipitate is inert before filtration; if doubt exists, the prescription should always be dispensed *unfiltered* with a "Shake" label. In this prescription precipitation occurs almost immediately, but the precipitate is composed of inert matter, and is caused mainly by the fixed oil in the tincture of nux vomica and the pectinous matter in the compound tincture of gentian. Strong alcohol is the menstruum used in making the tincture of nux vomica, diluted alcohol that for the compound tincture of gentian, while that used for the compound tincture of cinchona is 80 parts of alcohol, 10 parts of water, and 10 parts of glycerin. It must follow that when such tinctures are mixed some precipitation occurs, but in this case there is sufficient alcohol and water present to retain the active principles of each in solution, and filtration is admissible. Some conception of the extent of the knowledge of the physical and chemical characteristics of medicinal substances

necessary to meet the emergencies of prescription-work is afforded by due consideration of chemical and physical incompatibility.

Therapeutical Incompatibility in prescriptions is the condition produced by the injudicious combination of medicinal substances that are therapeutically opposed to each other.

The combinations of therapeutic agents which are intended to produce certain results form appropriate subjects for consideration elsewhere in this work, and hence are not treated of in this place. The following table of incompatibles may be found useful, although necessarily brief; it is of course impossible to compile a table to cover all combinations:

Brief Summary of Incompatibilities.

Acid arsenious, with lime-water, ferric oxide, magnesia.

Acids generally, with alkalies, acetates, metallic oxides.

Albumin, with acids, alcohol, tannin, corrosive sublimate.

Alkaloidal salts generally, with tannin, alkalies, alkaline and earthy carbonates, iodine and its compounds, liquorice, strong mucilages, alkaline and ammoniated tinctures.

Alum, with alkalies and alkaline carbonates.

Ammonium bromide, with mineral acids, alkaline carbonates, chlorine, chlorate and bichromate of potassium, nitrate of silver, calomel.

Apomorphine (*hydrochlorate*), with carbonate and bicarbonate of sodium, salts of iron, iodine, and tannin.

Barium chloride, with sulphuric and phosphoric acids and their salts, tartrates, and carbonates, medicinal wines, and vegetable infusions.

Bicarbonate of sodium, with acids, tannin, salts of the metals and of the alkaloids.

Bismuth subnitrate, with tannin, sulphur, sulphide of antimony, calomel.

Chloral hydrate, with water (slow decomposition), warm water, alkaline carbonates, vegetable alkalies, ammonia salts, nitrate of mercury, calomel.

Chlorate of potassium, with mineral acids, organic substances, sulphur, carbon, calomel, iodide of iron, etc.

Chlorine (*chlorine-water*), with alkalies, alkaline carbonates, salts of ammonia, vegetable salts, nitrate of silver, lead salts, tannin, vegetable mucilages, extracts, waters, infusions, tinctures and syrups, milk, and emulsions.

Corrosive sublimate, with carbonates, lime-water, iodide of potassium, opium, vegetable infusions, tannin; but compatible with the carbonates of lime, barium, and strontium.

Digitalis, with tannin, sugar of lead, iodine, iodide of potassium, alkaline carbonates.

Golden sulphide of antimony, with bicarbonate of sodium, cream of tartar, calomel, subnitrate of bismuth.

Gum arabic, with chloride of iron, lead salts, alcohol, ethereal tinctures, borax.

Iodine, with ammonia, starch, metallic salts, fatty or essential oils, emulsions, chloral, earthy carbonates, gum arabic, tragacanth, salep.

Iron, powdered (*iron reduced by hydrogen*), with aloes, vegetable infusions and extracts, tannin, metallic and alkaloidal salts.

Iron salts, with alkaline carbonates, vegetable infusions and extracts, tannin, mucilage.

Lime-water, with acids, carbonates, ammonia, salts, metallic salts, tartrates, infusions, tinctures, tannin.

Musk, with acids, acetates, tannin, ergot of rye, metallic salts.

Nitrate of silver, with hydrochloric, sulphuric, acetic, and tartaric acids and their salts, hydrocyanic acid and its compounds, iodine, iodide and bromide of potassium, alkaline and earthy carbonates, sulphur and sulphide of antimony.

Nitrite of amyl, with tinctures, alkaline carbonates, calomel, lead salts, ferrous salts, iodide of potassium.

Opium, with alkaline carbonates, salts of the metals, tannin, iodine, chlorine-water, and nux vomica. Although opium and belladonna are supposed to be physiologically incompatible, they are often administered together with good results.

Pepsin, with alcohol, tinctures.

Permanganate of potassium, with organic substances.

Salicylic acid and salicylate of sodium, with iron salts, iodide of potassium, lime-water.

Strophanthus (*tincture*) in water undergoes hydrolysis, with formation of a toxic substance.

Tannin, with mucilage, all metallic salts, lime-water, alkaline carbonates and bicarbonates, egg-albumin, gelatin.

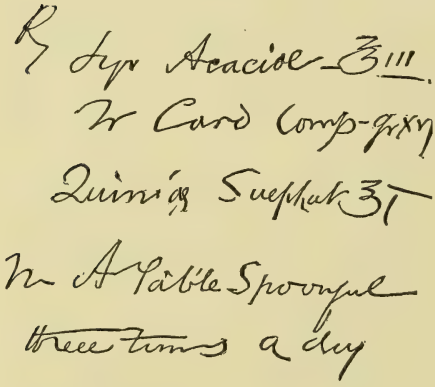
Tartar emetic, with acids, alkalies, soap, calomel, tannin, rhubarb, cinchona, gum arabic, opium.

Faults in Prescription-Writing.

The following *facsimiles* are a few selected from the author's work on *The Practice of Pharmacy*, 2d ed., p. 1017. They are presented with the view of showing some of the more prominent faults in prescription-writing. They are exact reproductions of prescriptions taken from active files, and they give some idea of the perplexities and difficulties besetting the life of the apothecary, who necessarily must be an expert in deciphering all kinds of marks on paper. Fig. 46 shows a

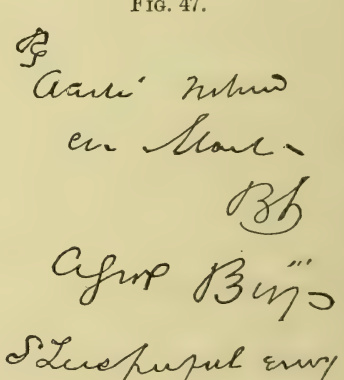
common fault; it is known as "transposition," and is caused by the habit which many physicians have of writing down the ingredients first and then placing the quantities in afterward. In this case the marks were transposed: "gr. xvj" should have followed "quiniæ sulphat," and "ʒj" should have been placed after "Tr. card. comp." In a glaring case like this the apothecary would usually correct the prescription, and notify the prescriber of his action if the circumstances were such that he could see the physician personally and have the correction made without the patient's knowledge. This would be his proper course, but such action often means a loss of time that would be very inconvenient, to say the least. Of course where the supposed transposition is not so evident the duty of the pharmacist is clearly one of non-interference, and he would not be justified in dispensing the prescription without revision from the author.

Fig. 46.



Transposed Prescription.

Fig. 47.



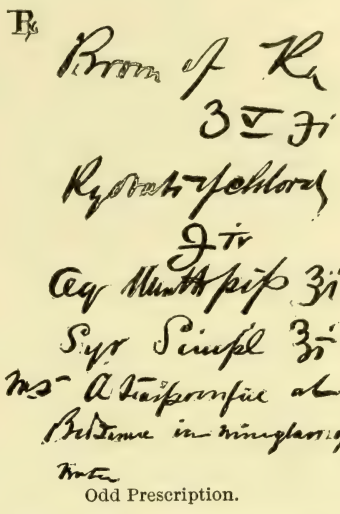
Badly-written Prescription.

In Fig. 47 is seen not only bad writing, but the fault of not using a whole line for a title, as well as that of not using official names for preparations. In this case the prescriber wanted "Acidum nitro-hydrochloricum," or, in the old nomenclature, "Acidum nitro-muriaticum," but having forgotten, or possibly having never known, the correct title, he writes "Acidi nitric et muriat., fʒss." This fault often leads to perplexities not easily solved.

Fig. 48 shows the same fault of not using a full line for each ingredient and quantity, as well as the careless habit of employing chemical symbols for abbreviations, with the use of Latin and English terms hopelessly mixed. Fortunately, there can be no question as to the intention of the writer here: he wishes 320 grains of bromide of potassium and 80 grains of hydrate of chloral, dissolved in a mixture of

1 fl. ounce each of peppermint-water and simple syrup. Incidentally, it may be stated that the official name for "syrup" is "syrupus," and not "syrupus simplex." The name "simple" syrup has not been authorized since the Pharmacopœia of 1820. Surely seventy years is long enough to get rid of a bad habit. There is no more necessity for using the term "simple" before syrup than before alcohol, glycerin, or any other liquid used to make both simple and compound preparations, it being understood that when the word "compositus, -a, -um" is not affixed the "simple" preparation is wanted. For the same reason "simple" cerate and "simple" elixir are misnomers.

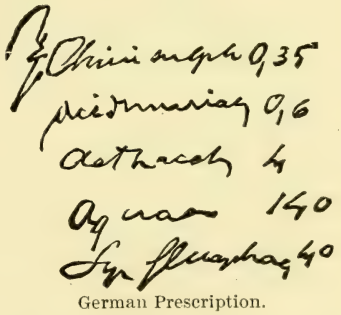
Fig. 48.



Odd Prescription.

Fig. 49 shows an involved German prescription. This is of course metric, recognized at once by the use of Arabic numerals instead of Roman characters. This prescription is not volumetric, but gravimetric, and the liquids are to be weighed instead of measured. The last ingredient is puzzling for even a bright son of the "Fatherland." The translation is, thirty-five centigrammes of sulphate of quinine (chin. sulph.), sixty centigrammes of hydrochloric acid, four grammes of acetic ether, one hundred and forty grammes of water, and forty grammes of syrup of orange-flower (fl. naphæ).

Fig. 49.



German Prescription.

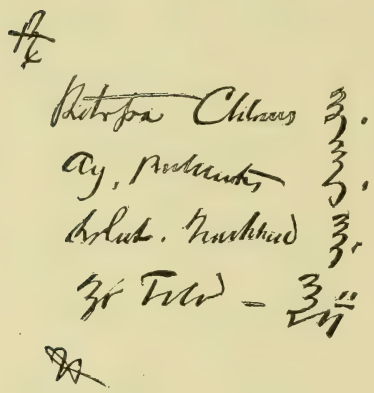
The advantages of metric prescription are plainly shown here, notwithstanding the indistinctness of the ingredients, for there are no puzzling, ℈, ʒ, and ℥ marks to worry over, and the figures indicating the quantities cannot be mistaken.

Fig. 50 illustrates how "hurry" mars the appearance of a prescription. The writer has quickly scratched down the ingredients, and then in putting down the quantities, all in a row at once, has run them together, so that the whole is difficult to decipher. One ounce of potassium chlorate is to be dissolved in a mixture of one fluidounce each of boiling water and solution of morphine, and two fluidounces of syrup of tolu.

Fig. 51 shows faults of a serious character: improper abbreviation has caused loss of life a number of times. "Hyd Chlor" may mean

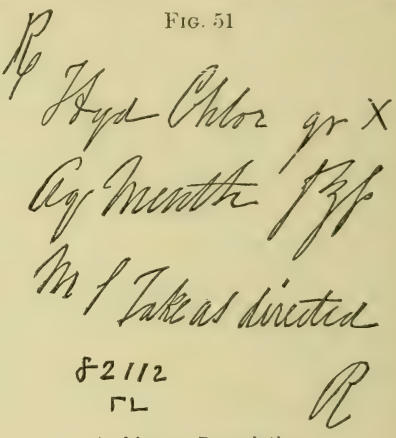
calomel, corrosive sublimate, or chloral hydrate. The dispenser who "jumps at" conclusions might imagine that a soothing draught of

Fig. 50.



Carelessly-written Prescription.

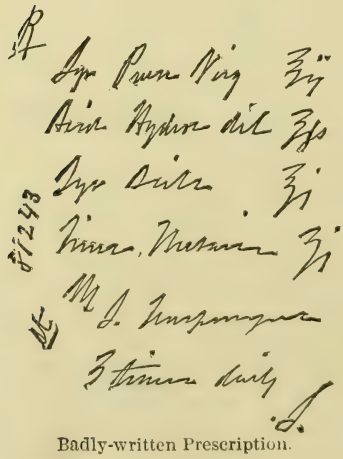
Fig. 51



Ambiguous Prescription.

chloral hydrate and mint-water was intended, and that verbal directions were given to the patient how to take it; but the careful pharmacist would ask the patient whether he wanted the directions put on the label, and what the directions are: this brings the information that it is a dose for biliousness, and the doctor said "to take the whole quantity at once." This surely does not mean that either chloral hydrate or corrosive sublimate was wanted, but calomel, and so it proved to be. Mint-water might mean either peppermint-water or spearmint-water, and a memorandum should be made of the ingredients on the prescription at the time that it is compounded, so that in case of renewal the patient will receive exactly what he did originally.

Fig. 52.



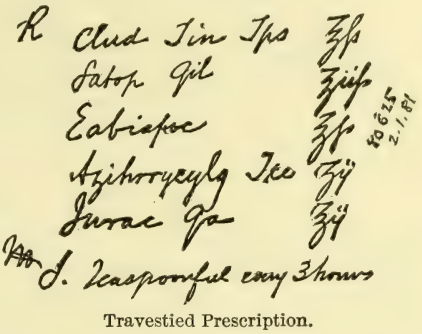
Badly-written Prescription.

In Fig. 52 is seen an illustration of one having several common faults. The use of antiquated terms is sometimes excusable, particularly when the intention is to prevent the patient from translating the ingredients. Thus, "Tinct. thebaici" is a name sometimes used instead of "Tinct. opii." Indistinctness, hurry, evidences of improper abbreviation are the principal faults, however. The prescriber wishes two fluidounces of syrup of wild cherry, half a fluidrachm of diluted hydrochloric acid or diluted hydrocyanic acid (the dispenser will have to guess at this, refuse the prescription, or see the doctor; it happened that diluted

hydrocyanic acid was wanted here, as it was for a cough mixture), one fluidounce of syrup of squills, and one fluidrachm of tincture of opium.

Fig. 53 shows what is termed a travestied prescription: it has been contrived so that the uninitiated might not be able to compound it. A physician writing such a one would tell the patient to take it to a certain druggist; of course he had previously arranged with the druggist the terms and the secret. No difficulty is experienced in compounding it if the names of the ingredients are spelled backward. The writing of such a prescription is inexcusable; no reputable physician would ever be guilty of issuing it, for even if it is not intended to get from the patient an additional fee (but merely written to prevent the patient from reading it), it bears a most suspicious "ear-mark."

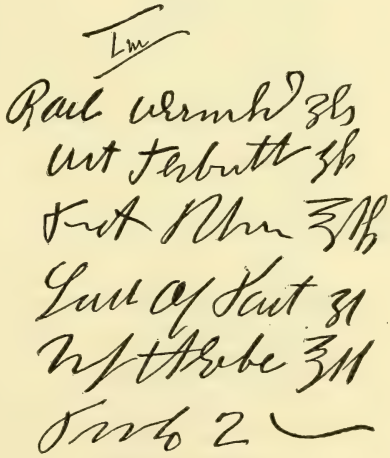
Fig. 53.



Travestied Prescription.

Fortunately for the pharmacists of Philadelphia, no more prescriptions quite like that shown in Fig. 54 are produced at present. The physician who wrote it had a very large practice, but seemed entirely to ignore all standards and rules in writing prescriptions. Fig. 54 is by no means the worst specimen in the author's collection, but a fair idea of the prescriber's style may be gleaned from it. He intended half a fluidrachm of oil of wormseed, half a fluidrachm of oil of turpentine, half a fluidounce of tincture of rhubarb, one drachm of "salt of tartar" (potassium carbonate), two fluidounces of mucilage of acacia (mu. arabe). The hieroglyphics at the bottom mean "A tea-spoonful every 2 hours." It will be noticed that Latin and English synonyms are hopelessly confused, and obsolete terms, faulty abbreviations, misspelled words, and nearly all of the sins on the calendar, have been committed.

Fig. 54.



Illegible Prescription.

Fig. 55 represents a dangerous abbreviation. It will be seen that it is an addition to a prescription, and, although the physician who wrote the prescription is usually a careful prescriber, there is ambiguity

about the fluid extract that he wishes to add to "29468." Is it fluid extract of jalap or fluid extract of jaborandi that is to be added? It proved to be jaborandi, and it was necessary to return the prescription to its author before the point could be settled.

FIG. 55.

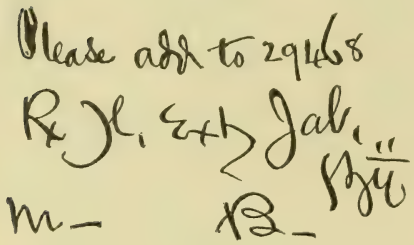


Fig. 56 is not shown as a specimen of bad penmanship or as an example of illiteracy, for the characters are fairly well formed, the terminology is above the average, and no ambiguity is noticed about the ingredients, but the number of the latter is startling: polypharmacy of a most pronounced type is here discovered. The physician who wrote it is a firm believer in compound prescriptions, and the author has in his collection two more prescriptions written by the same prescriber, each containing as many ingredients as seen in Fig. 56. Of course there can be no attempt made to indicate the therapeutic action of such a mixture.

FIG. 56.

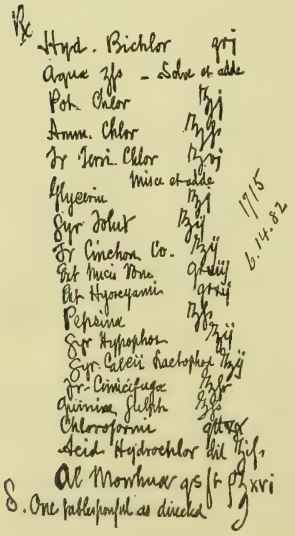
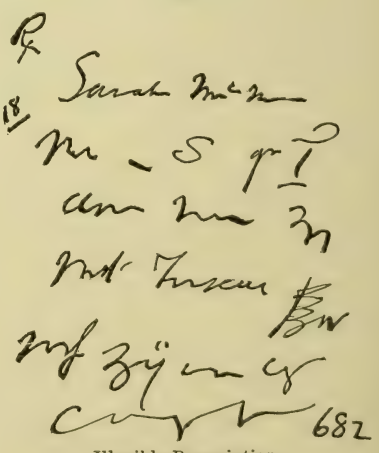


FIG. 57.



Illegible Prescription.

Fig. 57 illustrates an "out-patient" prescription written at a clinic by a physician in a hurry. It fortunately fell into the hands of a skilful and conscientious pharmacist (since deceased), who had been in the habit of reading such scrawls, and he had no difficulty in translating it in this way: "For Sarah McM——. Sulphate of morphine, one grain; ammonium muriate, one drachm; brown mixture, four fluid-ounces. Take two tea-spoonfuls in water for a cough."

ELECTRO-THERAPEUTICS.

By A. D. ROCKWELL, A. M., M. D.

The General Therapeutical Action of Electricity.

The use of electricity in medicine has become so thoroughly popularized that it is the exception to find a practitioner without some form of electrical appliance, and yet there seems to be in general a very indefinite appreciation of the effects of the passage of the current through living tissue, upon which are based the rationale of every electro-therapeutical result. The activity that prevails in this fascinating field of research is too frequently an activity without insight—an activity guided by no true appreciation of the laws which govern and the principles which underlie the subject. In the twenty years that have elapsed since the writer, in conjunction with the late Dr. George M. Beard, enunciated those ideas in regard to the general therapeutical action of electricity which gave the first efficient impulse to electro-medical and electro-surgical investigation in this country, the literature of the subject has accumulated beyond measure, and yet so little correct understanding is there of its physics that it is necessary to emphasize the statement again and again that electricity is not a simple, single manifestation of natural force, but is a generic term including complex phenomena and a wide variety of manifestations.

To understand its physical and physiological laws is to appreciate the fact that it is a many-edged weapon.

Is it a stimulant? Undoubtedly it is a stimulant of the most powerful character, and an ugly irritant as well when this side of its nature is sought after. Is it a sedative? As a sedative it is in some cases unequalled, and can generally be relied upon to soothe in greater or less degree a functional hyperæsthetic condition of the nervous system. Whether the word "tonic" should be dismissed from the vocabulary of medicine, as some have asserted, calls, it seems to me, for very little serious discussion. The derivation of the term from the Greek $\tau\epsilon\acute{\iota}\nu\omega$, "I stretch," and from still another word, $\tau o\nu\theta\omega$, "I brace or give vigor," is sufficiently suggestive. We speak of toning a violin, so that its strings give forth a clearer and better sound. We do this by making them more tense. By this figurative allusion our treatises on materia medica and therapeutics describe tonic medicines

as those which gradually produce the requisite degree of tension of the nervous system and of the living fibre generally, and which enable it fitly to respond to all of its natural and appropriate stimuli. "The idea of tension is inseparably connected with all our notions of vital force, because the most common, if not the only, conception we possess of organic power is derived from our experience of the phenomena of muscular force, which is always displayed in connection with the tension of muscular fibre."

Admitting, then, the recognized significance of the word "tonic," and that remedies for improving the tone of the system still hold an important position in the classification of the materia medica, in my judgment electricity must be classed as a tonic of a very high order. It possesses varied influences of this kind, according to the kind of current used and the method of its application. To produce that tension of the nervous system and of the muscular fibre generally, so as to enable them to respond to their natural stimuli, the mechanical effects of the faradic current seem especially adapted. It is a current of alternation, of to-and-fro motion, of constant closing and breaking. Unlike the galvanic current, it possesses no chemical action to be feared, and no powerful reflex effects need render us unduly cautious in its use. In the passage through the body of a current interrupted with the requisite degree of rapidity it need produce no appreciable muscular contractions, but yet it gives passive exercise to all the deeper-lying as well as superficial tissues. The numerous branch currents going to and fro act as so many shuttlecocks, keeping every atom in incessant disturbance.

Aside from these purely mechanical effects, the experience of every electro-therapeutist must teach him that even the induced or faradic current exerts some other and more subtile influence upon the nerves themselves, for by no purely mechanical effect can we account for the numerous phenomena that follow its use in diseased conditions.

While these mechanical effects of electricity are constantly observed after simple local applications, yet he who uses this form of electricity in local pathological conditions only, and exclusively for its local effects, will fall far short of eliciting its full therapeutic power. It is this appreciation of the broad therapeutic action of electricity, and a knowledge of the details of the general methods of application necessary for its production, that have aided in the success of so many charlatans. They have accomplished results along certain lines far more satisfactory than those of the scientific physician, who has restricted his excursions in electro-therapy to purely localized methods of application.

Electricity, then, after the method of general faradization may be said to be indicated wherever a constitutional tonic influence is called for. This law renders the remedy as valuable to the general practi-

tioner as to the specialist. For the tedious period of convalescence that often follows typhoid and typho-malarial fevers there is no remedy that is comparable to it, and in a large number of conditions of depressed vitality, electricity, in some one of its forms and by some one of its methods of application, will prove of more or less service. It gives passive exercise to the muscles, it promotes and renders more natural the processes of excretion and secretion; in a word, it imparts tone and strength to both nerve and muscle. With these general principles before us we cease to wonder that electricity is used and recommended for such a great variety of diseases, many of them of an apparently opposite character, and we see the injustice of that criticism which condemns electricity because it is claimed to be of service in so many different conditions. When the therapeutic efficiency of electricity is denied, the inevitable conclusion at which those must arrive who have time and again witnessed evidences of its power is, that he who thus fails in his results is deficient in his experience, is not sufficiently persistent, or has somehow failed in the technique of his applications.

Some of the results in electro-therapeutics are due in a measure—although not in great measure, I apprehend—to physical effects. The heat excited in the tissues by the passage of either form of current is undoubtedly small, but, judging from analogy as well as facts, there can be little question but that an appreciable degree of heat is excited. All conductors of electricity become heated more or less according to the degree of their resistance, and as the body offers great resistance a certain proportion of the electric force must be converted into heat. It is, at all events, a demonstrated fact that cold extremities are sensibly warmed by faradization or galvanization, even when but few muscular contractions are produced.

Electricity possesses well-known physical effects on metals. Platinum wires are contracted by the passage of electric currents through them, and copper wires that are freely used for conductors become brittle, and it is said that the copper wires that conduct faradic currents break more speedily and more frequently than those which conduct galvanic currents. These physical facts are very suggestive of what may be facts in physiology and pathology sufficient to account for some of the therapeutic effects of electrization that as yet have hardly emerged from the realm of empiricism. These possible physical and physiological changes apply especially to the after or secondary effects of electrical treatment—effects that are noticed, not while the applications are being made or during the course of the treatment, but weeks and months after the treatment has been discontinued.

The chemical or electrolytic influences that are associated with electrical action are practically confined to that form of dynamic electricity that is termed galvanism. Its visible effects occur when needles or

pointed electrodes of metal are used, and its especial utility is in the department of electro-surgery, although it is undoubtedly true that some electrolytic action occurs in all ordinary applications of galvanism to the body whatever form of electrode is used, and is probably a factor of more or less efficiency in making up the sum of electro-therapeutical effects.

A distinction has been made, and justly, between electrolysis and galvano-chemical cauterization. The one is a disintegration and separation of the constituent elements of organized structure. The other produces its effects by means of the acids and alkalies that are liberated at either pole by electrolytic action. It is the chemical galvano-cauterization, and not the electrolysis, that accomplishes most of the good results that follow intra-uterine applications in cases of endometritis, and yet that the beneficial effects are not due solely to the acids and alkalies is evident from the fact that when ordinary acids and alkalies are applied to the body, eschars of the same degree and kind are not obtained. The current penetrates and pervades the tissues, and induces various changes beyond and beneath the eschar which continue long after the current ceases to flow.

In its influence over nutrition, however, the physiological effects of electricity are perhaps the most important. Mechanical, physical, and chemical effects must indeed combine to make up physiological effects. The former are observed on dead as well as living, on inorganic as well as organic, substances; the latter are peculiar to the living body only. Physiological effects are those which take place by virtue of the vital properties of the body, and cease when life ceases. The action of either current modifies physiological function in various ways.

First. It may increase it. This action of the galvanic current is so well known as hardly to need mention. The readiness with which the secretion of the salivary gland can be increased is readily demonstrated. Mucous secretions are very quickly increased by the action of either current, and the effects of electrization are being utilized more and more in diseases characterized by a suppression of the normal mucous secretions. Especially in the so-called dry catarrh is the treatment efficacious, as has been shown in many cases. The effect of electricity on the biliary secretion, on the gastric juice, and on the intestinal fluid, is probably stimulating, but is less easy of mathematical demonstration. Certainly, these fluids ought to be secreted in greater abundance under the influence of the current, and the results of treatment in pathological cases give this probability something of the force of certainty. My own experience is that the appetite is sharpened, digestion quickened, and constipation relieved both by local and general electrical treatment —so decidedly in many cases as to make it pretty evident that the gastric and intestinal glands are made to secrete more liberally by the

action of the current upon the nerves that supply these organs than on the tissues of the organs themselves. These results, that have been familiar to me for years, have recently been confirmed by Ziemssen in a very interesting manner by experiments on animals. He found that either form of current would increase the secretion of the various glands.

The subjective effects of the electric treatment act the same way in the bowel as in the stomach, by invigorating and improving the appetite. In the bowel it diminishes or removes the painful tenderness in the lower part of the body, as well as the feeling of movement or heat that is frequently experienced. The objective effects of the treatment Ziemssen conjectures to be that the stimulation of the motor nerve excites the intestinal ganglia, and thereby increases the flow of secretion from the intestinal glands, as well as induces a flow of the pancreatic and biliary secretion.

Among those affections of the bowels in which electricity is quite certain to exercise a beneficial influence are defective innervation, atrophy of the muscles of the bowels, digestive atony, and that large class of diseases comprehended under the name of hypochondriacal and neurasthenic.

Second. Electricity may not only diminish, but it may arrest, the physiological activity of the organs of secretion and excretion.

When, as in polyuria, the general application of the current is often followed by a marked diminution in the flow of urine, it is a desirable therapeutic effect, but the effect to which I allude is far from desirable. It comes from the use of currents so strong as to paralyze glandular function. On the lacteal secretion it acts with decided though varying power in increasing it, or in restoring it after it has been temporarily suppressed; but in two cases I have known this secretion to be promptly suppressed by the injudicious use of currents of high tension. On the circulation the influence of electricity is a complex study, since it comprehends its action on the heart and on the unstriped muscular fibres of the arteries, as well as upon the central and peripheral nervous system.

Certainly, very sensible modifications of the circulation may be observed in any strong and prolonged application of either current, and generally on the side of an increase of the flow of blood and some elevation of temperature, with dilatation of the veins.

On the absorbents the action of electricity has been found to be of practical value in relieving many hypertrophies, effusions, and morbid growths. To follow out the rationale of its operation in producing these effects would be a difficult and tedious task, and it can only be said here that the effects of electricity on the excretory processes of the body, its direct chemical action, and its influence over the circulation

in the arteries, veins, and capillaries by its power to increase the quantity and quality of innervation received by them, must constitute most important factors in influencing the process of absorption.

The Dosage of Electricity.

The more thoroughly one studies electro-therapeutics in all its relations, medical and surgical, the clearer it becomes that the real scientific basis for the use of electricity in medicine and surgery is found in electro-physics more than in electro-physiology.

The rationale, therefore, of the various methods of electrization, of galvano-cauterization, and the important department of electrolysis can be satisfactorily understood by those only who have grasped the elementary principles of electro-physics—the laws of resistance and conductibility, and, above all, the law of Ohm. Those who have been once well grounded in these laws of electro-physics find that the various special problems that arise, whether of a theoretical or practical character, very quickly resolve themselves.

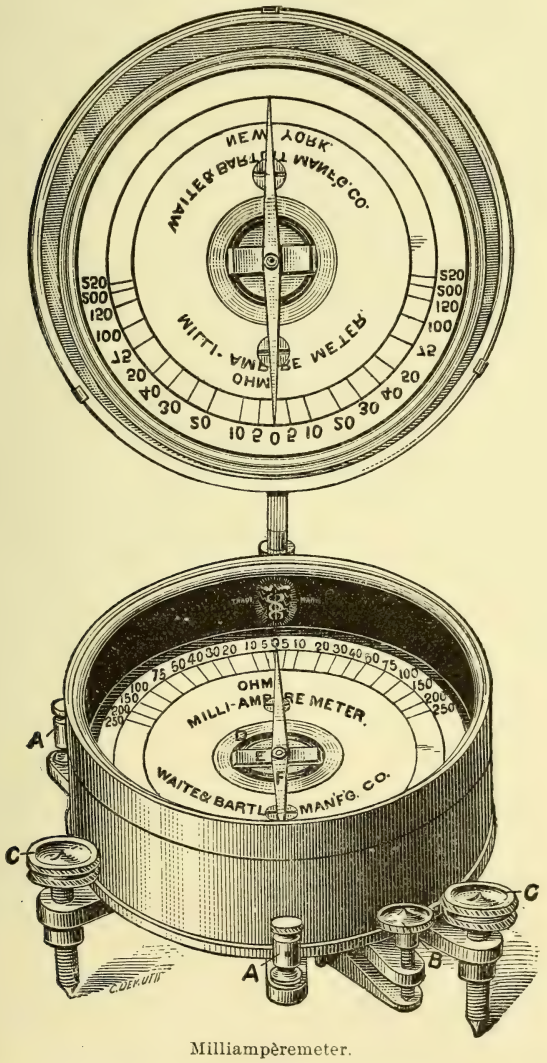
I do not propose here, however, to discuss the complicated subject of electro-physics, but to offer a few practical suggestions in regard to the important topic of electric dosage.

In some conditions and with some individuals the difference in result between a very gentle and short application and a very strong and protracted one is nothing more nor less than the difference between agreeable success and painful failure, while in other conditions and with other individuals the difference between success and failure is measured by the difference between strong and short applications and mild and protracted ones.

There are persons who must be treated not only mildly, but at long intervals; and there are persons, with perhaps the same maladies, that can bear with advantage powerful and frequent applications: to distinguish between these classes, and the various gradations that lie between the extremes of tolerance and of susceptibility, is the first duty, and oftentimes the hardest study, of him who makes much use of electricity in medicine. To state in definite terms the solution of the problem of electric dosage as it relates to these various classes and gradations is a task that I by no means propose to undertake. The ability to measure with the utmost nicety the strength of the current does not solve the problem. Such precision may be of the utmost value in the continued treatment of any given case of neuralgia, for example; but the strength there used may in no way answer for the next case, and therefore recorded statements of the number of milliampères used, in different forms of nervous disease especially, are by no means as valuable as one might be led to believe. A clear appreciation of the fact that the human system reacts to no drug with such

varying susceptibility as to electricity is one of the first and most important lessons to be learned. When we come, however, to the department of electro-surgery as represented by electrolytic action, the case is widely different. To produce certain local effects requires a certain definite expenditure of force, and the question of idiosyncrasy

FIG. 58.



Milliampèremeter.

cannot be so much considered, although even here it is not to be altogether ignored.

The "dead-beat" milliampèremeter (Fig. 58) is a great improvement on the old form of galvanometer for measuring the strength of the galvanic current. Many of the meters even now in use register

but forty or fifty milliampères, and oscillate so persistently as greatly to inconvenience the operator.

This instrument of precision by means of two short coils will accurately measure as high as five hundred or as low as one-tenth of a milliampère. The dead beat or damping effect is obtained by suspending the needle in a cylindrical block of copper three times the diameter of the needle. The current in the copper, induced by the swinging of the powerfully magnetized needle, causes the number of its oscillations to be reduced to three or four, making it possible to take a reading instantly. In some meters these oscillations amount to thirty or forty. The milliampèremeter has been used in therapeutics but a comparatively short time, although for many years nervous as well as other diseases had been treated by electricity with different degrees of success, according to the individual experience and skill employed in its use. Personally, although acknowledging the great utility of accurately measuring the strength of the current, I cannot claim greater success in the treatment of most nervous diseases, now that the milliampèremeter is employed with every application, than formerly when it was unknown; and this experience is, I fancy, common to all those who have through years of work become practically familiar with the routine of electro-therapeutical treatment.

And yet it is an immense convenience. It relieves the mind of all anxiety in regard to many minor details, and he who has once tested it will never willingly be without it. For the tyro, however, it is, I am sure, a necessity. Without it he will find himself working entirely in the dark, and a beginner should no more think of attempting serious work without his indicator of current-strength than he should administer drugs without his apothecary's measure.

Another appliance convenient to have, but not always essential, is the rheostat, the utility of which I will briefly illustrate. To-day, for example, the observer notices that the current from a given number of cells is painfully felt by the patient, while to-morrow the same strength, applied to the same patient, may be felt but slightly. If no milliampèremeter is used the mystery seems very great, and I know not how many times I have been asked for an explanation. If, however, the current is measured, the mystery is solved, for it is observed that when pain follows the application a greater number of milliampères is registered than when no pain is produced.

All this is explained by the fact that the skin varies very much on different portions of the body and in different physical conditions as to its conductibility. Now, if on one day, in an application to a patient of a current from thirty cells, the meter registers thirty milliampères, and on the next the same number of cells, with the electrodes applied on the same portions of the body, cause the meter to indicate but

twenty, we know that the patient is offering a far greater resistance to the current on the second day than on the first. It is not essential for practical purposes that we know just what that resistance is, but it is desirable and interesting to know, and the rheostat supplies this knowledge with absolute exactness. In order to find out the resistance when the registration is thirty, we substitute a rheostat for the body of the patient, and introduce a number of ohms in the circuit sufficient to hold the needle at thirty. If the number of ohms found necessary is three thousand, then three thousand is exactly the resistance offered by the body of the patient on the first day. To find out the resistance when the meter registers but twenty the same process is repeated, and if the number of ohms registered is five thousand, we know that five thousand ohms is the amount of resistance offered.

The utility of the rheostat in therapeutics is more especially in the direction of enabling us to increase or decrease the current gradually and without shock. After intercalating a resistance of one thousand or more ohms, we bring into action the number of cells that will probably be required. By gradually reducing the resistance in the rheostat the milliampèremeter soon marks the degree of quantity required. To decrease the current the resistance in the rheostat is as gradually increased until the needle points to 0, an indication that the resistance equals the strength of the current. The Germans taught the use of ridiculously weak currents, and, influenced by these teachings and by a natural respect for an agent so subtile, the average degree of strength employed when I began the use of galvanism was in many cases entirely inadequate. In its application to the head ten or twelve cells were, as a rule, considered quite sufficient. Beneficial results were often seen to follow such mild treatment, it is true, and it was seldom that greater strength was attempted; but that the dose of electricity thus obtained was exceedingly slight, and far more inefficient than was then supposed, can be readily demonstrated. The cephalic electrode was a broad, thick sponge, while the other electrode, applied generally to the pit of the stomach, was of sponge also, but much smaller. The resistance thus offered is necessarily very great, and if the milliampèremeter is used, it will be found that the actual quantity of electricity passing through the body of the patient hardly exceeds six or seven milliampères. Now, to use a current of only this strength in applications to the nerve-centres is, as a rule, little more than child's play.

Sometimes benefit may undoubtedly accrue from these very mild applications, but I have for so long a time observed the effects of a bolder line of treatment that I have no hesitancy in advocating it in preference to former methods. In place of a current of five or six milliampères substitute one of twenty, and the superiority of the results thus obtained will soon become manifest. But if, by the method in

common use, twelve ordinary cells in the treatment of the head deflects the needle but about five degrees, it would take some forty-eight cells to give a strength of twenty milliampères; and few physicians have any such number at command.

For this purpose the electrodes should be as large as possible; that is, broad, flat, or curved, according to the part of the body to which they are applied, but with little bulk. With electrodes such as these, and a series of sixteen Leclanché cells, a current of twenty milliampères can readily be obtained in applications from the head to the solar plexus. Thirty-two cells would therefore give forty milliampères, an intensity of current seldom necessary to exceed, or even equal, in central galvanization. In making these strong applications to the brain there is an element of danger which cannot be emphasized too strongly—namely, the possibility, and indeed the probability, considering the utterly haphazard way in which electricity is too frequently used, of the current becoming suddenly broken. Even with very weak currents applied to sensitive nerves or to the head interruptions are, as a rule, undesirable, and when strong, as indicated by a deflection of the needle of fifteen or more, they may painfully aggravate the very symptoms that you are endeavoring to allay. As an illustration of this most important fact, I will refer to two out of a number of cases upon which this statement is based.

The first was a case of epilepsy, one which had been helped up to a certain point only by the persistent use of the bromides, but which had very greatly improved, and finally recovered, when the treatment was supplemented by galvanization of the brain. The attacks had been growing far less frequent, and at this time some three months had elapsed since the last. The patient was feeling exceedingly well, and this in itself was by her regarded as a guarantee of exemption, for invariably before a paroxysm she was accustomed to feel far from well. With one pole at the epigastrium and the other on the head I was gradually increasing the current until it probably indicated some fifteen or twenty milliampères. In some way the connection was suddenly broken, and, with the characteristic cry, the patient fell over in an epileptic fit, and one, as I afterward learned, of far greater severity than usual.

The other was a severe case of chorea of long standing. The patient was slowly but surely recovering, and had so far regained command of his lower limbs that he could walk with but slight evidences of any lack of co-ordinating power, and could use his knife and fork with ordinary readiness. About this time he inadvertently received a shock through the head of a current-strength of some twenty milliampères. Results of a most unpleasant character followed. The choreic movements of the arms and legs returned in a marked degree, so that he

walked with uncertain steps and could no longer feed himself. These aggravated symptoms continued for about ten days, and then began gradually to subside.

I would by no means be understood to say that a galvanic shock, even though severe, will always cause marked increase of symptoms that are subsiding under the use of an uninterrupted stable current. Such shocks are many times given without any apparent evil result. They should, nevertheless, be guarded against in every possible way, as their tendency is undoubtedly harmful.

One of the diseases to which I will refer in giving more definitely my own experience in regard to electric dosage is epilepsy, a condition in which electricity is far from being generally recognized as capable of any special service. As far back as 1878, I wrote upon the subject, and recently gave, before the New York Academy of Medicine, the results of my observations in twenty-eight cases. All of these twenty-eight cases of epilepsy were treated without the aid of accurate current-measurement, since the milliampèremeter is of comparatively recent introduction. It is, however, possible for me to give approximately the strength of current used in most of these cases. The range was between ten and thirty milliampères. I have found no patient suffering from epilepsy who could not endure, without ill effects, a current of ten milliampères, provided the cephalic electrode covered a surface sufficiently large and was accurately adjusted, while most of them bore without discomfort a much stronger current. I should regard more than thirty milliampères seldom if ever desirable. The strength that I have found most generally acceptable and of service to my patients has been from fifteen to twenty-five milliampères.

In chorea substantially the same rule prevails in regard to strength of application, or would prevail if the average age of choreic patients was not much less than that of epileptics. The strength of current applied to the head in any case of chorea under twelve years of age should rarely exceed twenty milliampères, and generally should be about twelve.

We cannot approximate the relative dose of electricity for different ages as accurately as we can that of drugs. The following observations, however, will be found to be uniformly correct. The very young bear proportionately very much stronger currents than adults. A child of three years, who should, according to rule, tolerate only about one-fifth the adult dose of any powerful drug, will easily bear one-third, and sometimes one-half, the adult dose of electricity. Old people bear stronger currents than those in middle life; it is, indeed, quite astonishing to observe the very marked insusceptibility of some very old people to electricity, due in some measure perhaps to blunted sensibility, as well as to a loss of conductibility of the tissues, and especially of the skin.

It will not answer, however, to presume too much in the application of electricity to the old on account of this apparent insusceptibility, as it is not uncommon to meet with persons advanced in years who, while they may feel the application of a certain strength of current but little at the time, are yet exceedingly susceptible to its secondary effects.

Another disease for the relief of which the galvanic current is but indifferently appreciated is exophthalmic goitre. Without it, indeed, it is often impossible to obtain results at all satisfactory, but with it marked amelioration of the symptoms almost invariably follows, and not infrequently complete or approximate recovery in cases that have responded unsatisfactorily to internal methods of treatment alone. The strength of current indicated varies according to the position of the poles. An important point for local application is the auriculo-maxillary fossa, immediately below the lobe of the ear, where but a comparatively small electrode can be used. A strong current would produce both pain and vertigo, and from five to seven milliampères is about all that will be well borne with an electrode in this position. As we gradually move the pole down along the inner border of the sterno-cleido-mastoid muscle the strength can be increased very materially, and with one broad electrode at the back of the neck, near the sixth cervical vertebra, and the other on the enlarged gland, currents of twenty and thirty milliampères can be profitably utilized. The variation of current-strength in the treatment of neuralgia and pain in general is as wide as the symptoms are varied in character and seat, and more perhaps than in other diseases is it necessary to discriminate carefully in the selection of the proper current. True neuralgia (pain directly along and confined alone to the course of a nerve) calls almost invariably for the galvanic current, while the so-called pseudo-neuralgias, which are simply forms of pain occupying certain areas and running seemingly in the direction of certain nerves, yield most readily to faradism. From five to ten milliampères are, as a rule, amply sufficient for the relief of neuralgia about the face and head, while in sciatica, it is often necessary to use as much as forty or fifty, or even more. The efficacy of very strong currents in the treatment of sciatica should be more generally recognized. As ordinarily used, it often fails to relieve because of an insufficient current. The operator is simply self-deceived. He is using perhaps a large number of cells, freshly and properly charged, but his electrodes are of a pattern and size to offer the greatest possible resistance. Let him substitute electrodes that are broad and flexible, readily adapting their shape to every inequality of surface, and this difficulty of lack of strength will quickly disappear.

In the treatment of paralysis, whether central or peripheral, the dose of electricity is determined by so many modifying factors that it cannot be fully discussed here. The general law, that when a muscle

fails to respond to the faradic current recourse must be had to the galvanic, is now usually appreciated, but it is not so generally understood that paralyzed nerves are not to be indiscriminately stimulated by sudden shocks. Many a paralysis that might have recovered has been made permanent by such ill-directed and culpable interference.

After the degree of quantitative or qualitative change has been determined by careful interrogation of the affected muscles, it is in many cases imperative to use the continuous and not the interrupted galvanic current. Especially is this true in those cases of local paralysis in which responses utterly fail to be elicited by the faradic current, but are more readily obtained through the galvanic current than in the normal condition of nerve and muscle. In such cases mild currents of about seven milliampères, increased to twelve or fifteen as improvement increases, and applied without interruption, will succeed in lessening the irritability of muscular fibre and in restoring the lost vitality of the intra-muscular nerves—upon the integrity of which the faradic current depends for its ability to call forth muscular contractions—far more effectually than when interruptions are attempted.

In most forms of paralysis, however, much stronger currents than these can be employed. In infantile paralysis fifteen or twenty milliampères may be used, and in the spinal paralysis of adults (polio-myelitis) twenty-five or thirty are usually indicated. In both these conditions, but more especially in infantile paralysis, the same rule should be observed as in the treatment of the form of facial paralysis to which allusion has been made—for the most part continuous and not interrupted currents.

Given a case of infantile paralysis in which reaction to the faradic current is entirely lost, and only faintly appreciable to the galvanic current, it is entirely possible by sudden shocks to obliterate the little remaining vitality and render the case incurable.

In hemiplegia, again, while electricity possesses but a limited value, it is yet capable of doing decided harm. I have at this time under observation a hemiplegic patient whose arm was in such a condition of heightened irritability that contractions to both currents were called forth far more readily than in health. He fell into the hands of one who possessed greater activity than insight, and was subjected to a series of treatments by the faradic current in which the muscles of the arm were jerked about in a most merciless manner. As might have been expected, there soon supervened an entire loss of motility, together with neuralgic pains of a distressing character.

In alluding to epilepsy and chorea, I spoke of central galvanization and its dosage in those diseases. Central galvanization is also a valuable method in many neurasthenic conditions, in hysteria, and in cases of melancholia. The hair being thoroughly wet, a light wire gauze

helmet, lined with some soft conducting material, is fitted as accurately as possible to the head. To this is attached the positive pole, while the negative is applied to the pit of the stomach and a current passed, varying, according to the disease and individual idiosyncrasies, from five to thirty milliampères. It may seem an easy thing to make use of central galvanization satisfactorily, but, like most easy things, its efficient use demands knowledge, care, and some experience; all of which are within easy reach of those who desire to utilize the method. The wide area which this helmet electrode covers lessens by just so much the resistance to be overcome, and enables us to pass through the head a current of many milliampères without pain or other ill result. To this end, however, the electrode must be made to adjust itself accurately to every inequality of surface, otherwise a painful concentration of current will be felt at various points and the efficacy of the application interfered with.

Any discussion of the subject of electric dosage would be incomplete without reference to gynæcology, in which electricity has accomplished much good. Here, more than in any other department of medicine, is illustrated the great superiority of strong and comparatively short applications, over those which are weak and prolonged.

Much of the ill-success that formerly attended the treatment of diseases of women by electricity was due to the use of too feeble currents, and the same misapprehension as to its actual working power, alluded to when speaking of central galvanization, existed here. With one ordinary small and comparatively thick sponge electrode applied externally to the abdomen, and the other internally, a current from thirty-six cells will cause a registration possibly of not more than twenty-five to thirty milliampères. A current of this strength is entirely insufficient with which to treat successfully many uterine diseases that experience has shown to be amenable to electrical applications; and in order to obtain the requisite strength without resorting to the great number of cells that would ordinarily be required, electrodes of an entirely different pattern are necessary. They should be large and flat, and readily adapted to every inequality of surface.

Apostoli, whose experience has probably been greater than that of any other in the electrical treatment of the uterus and its appendages, first suggested the electrodes made of sculptor's clay, held in place by gauze and sufficiently large to cover much, and sometimes the whole, of the abdomen. The principle involved is simply this: The larger the electrode, the less the resistance, and, other things being equal, an electrode of six square inches will yield but one-half the current of one of twelve square inches. In the treatment of uterine diseases it must be remembered that the internal is the effective pole, while the external is the indifferent or dispersing electrode. Bearing in mind also

that the genital mucous membrane is remarkably insusceptible to painful impressions, while the skin is the reverse, the necessity of large flexible electrodes that can be accurately adjusted is readily appreciated.

In the treatment of indurations and enlargements of the uterus and the exudations resulting from pelvic cellulitis direct applications frequently result in complete recovery. Currents of from thirty to fifty milliampères are indicated, and should not cause the slightest pain. On the contrary, there is often instant relief afforded to an ever-present pain, as well as the more remote results as seen in the correction of painful menstruation. If the metal electrode is applied directly, without the intervention of some covering, care must be taken not to use currents sufficiently strong to produce eschars. This mishap may occur even without the knowledge of the patient, and it is therefore always safer to use a covered electrode.

I have seen this treatment, judiciously and persistently carried out, melt away, as it were, not only large pelvic deposits, but in two instances relieve a most severe and chronic sciatica that had been caused by the pressure of these pelvic deposits. In ovarian and fibroid tumors the electrolytic method is undoubtedly worthy of consideration, although in ovarian tumors the results have not as yet been sufficiently satisfactory to commend themselves strongly to authorities in the department of uterine surgery.

It is perfectly safe to use currents of from one to two hundred milliampères in the treatment of uterine fibroids. Whenever in the use of electrolysis our aim is destruction, and only destruction, I see no reason why even stronger currents might not be used. In one case of uterine fibroid at a clinic at the New York Post-Graduate Medical School, I myself used a current-strength of three hundred and fifty milliampères.

It must be remembered, however, that some of the best results of electrolysis are not measured by the degree of chemical action, and that when various external tumors, such as goitre, disappear under feeble electrolytic action, it is through a process of absorption that is set up, and not because of the destruction of tissue. In the treatment of goitre currents of forty milliampères are indicated. Absorption is hastened by the chemical changes that occur, and takes place both during and after the treatment. In most cases it is not observed at all during the operation, but goes on slowly for weeks following.

Stimulation of absorption is especially marked when electricity acts on hydrocele and small cystic tumors. For their treatment a current of thirty to forty milliampères is required. In erectile tumors, in which the object is to coagulate the blood, we use about the same strength as when treating cystic tumors.

Current Differentiation.

A frequent question, and one somewhat difficult to answer without qualification, is, Which of the two forms of dynamic electricity is the more useful in practice? As generally used, undoubtedly the galvanic current has a wider range of usefulness in medicine and surgery than the faradic. In other words, and generally speaking, diseases and symptoms of disease that are circumscribed and local indicate, as a rule, the galvanic rather than the faradic current. If, however, a broader view of the remedial action of electricity be taken, and its powerful tonic influence recognized when administered by the methods demanded for the production of such effects, it is quite another matter, and the faradic current assumes an importance which any form of local use fails to give.

It may be said, therefore, that if the general practitioner will make himself acquainted with general faradization, and take the time and trouble to apply it with the thoroughness that its successful use demands, he will accomplish quite as much with the faradic as with the galvanic current, although in quite a different class of cases.

In briefly discussing the relative efficiency of the two forms of dynamic electricity in medicine, I will first consider the measure of their agreement and disagreement in their physical and physiological activities, and, second, state some of the differential indications for the use of the currents in treatment. The first of these considerations is necessary to an intelligent appreciation of the second, for the more thoroughly one studies electro-therapeutics in all its relations the clearer it becomes that the real scientific basis for the use of electricity in medicine and surgery is found in its physics and physiology, especially the former.

Now, electricity, however generated, whether through chemical action, through friction, or through induction, and however modified by its passage through any resisting media, is electricity still. Both currents, the faradic and galvanic, are obedient to the law of Ohm, and while there is a wide difference in the degree of their physical and physiological properties, these are in kind essentially the same.

Both currents are capable of producing electrolytic effects, and this can be readily demonstrated with the current from the first induction coil of an ordinary faradic apparatus. The action of this current on a solution of salt and water is exactly the same in kind as the action of the galvanic current. Both currents also evolve light and heat, and the bright deflagrating spark caused by the electricity as modified by the thick, short coil of wire is even more brilliant and disintegrates metal more readily than the current direct from many cells. Both currents will electro-plate, and by some of the giant magneto-electric apparatus this is done on an enormous scale.

The milliampèremeter is an instrument of precision that is now indispensable in the use of the galvanic current, and yet by connecting the posts with the poles of a faradic apparatus an appreciable deflection of the needle is observed, and this deflection very naturally becomes still more marked if the current from the primary coil is thus utilized. This power of the faradic current to cause, like that of the galvanic, electrolysis and deflection of the needle is so inferior in degree to the power of the galvanic current that we cannot utilize the former in electro-surgery, nor is the galvanometer available to measure its strength. Thus it can be readily demonstrated that, however differently generated or however modified by the medium through which they pass, the various forms of electricity are only different manifestations of one great force.

Physiologically, we find this agreement between the effects of the two currents quite as close as when physically considered. The phenomenon of electrotonos, to be sure, has been demonstrated only as it relates to galvanism, but it is the common experience that even with the faradic current the positive pole is the more calming, and the negative the more stimulating.

Applied directly to the brain or spinal cord, both currents excite muscular contractions, and about in the same degree, similar results having been obtained in the well-known experiments of Fritsch and Hitzig, who used galvanism alone, and of Ferrier, who used faradism. The result of direct electrization of the sympathetic nerve is a change in the calibre of the cerebral blood-vessels, and the only difference in the action of the two currents is the greater rapidity with which effects follow the application of the galvanic current. The nerves of respiration are affected in about equal degree by both currents, and even in their action on the nerves of special sense the close relationship of the two is unmistakably evident.

You cannot in a healthy person—or, as a rule, even in one that is sick—so excite the optic or gustatory nerve by the faradic current as to call into activity the vital function of these nerves. There are, however, some exceptions to this, as exemplified in certain hysterical and neurasthenic cases in which there exists an unusual susceptibility of the nervous system. In such cases the faradic current has occasioned not only the appearance of flashes before the eyes and a metallic taste, but the auditory nerve itself has been known to respond to its influence. These examples are quite sufficient to show that the action of the two currents is so similar as to prove them substantially the same in kind, but at the same time so widely do they differ in the degree of their physical and physiological power that it is often practically equivalent to a difference in kind, rendering one current inferior or superior to the

other in a most remarkable degree, according to the special indications in individual cases.

In view, therefore, of the superiority of the galvanic to the faradic current as relates to its physical and physiological energies, it seems hardly necessary to say that the former is to be used when we wish to act with special electrotonic and electrolytic power on the brain, spinal cord, the sympathetic, or any part of the central or peripheral nervous system. We use it when we wish to produce contractions in paralyzed muscles that refuse to respond to the faradic current, and in electro-surgery when we desire to produce, through electrolysis and cauterization, the destruction or absorption of morbid products and the coagulation of blood. We use the faradic current to act mildly (probably for the most part through reflex action) on the brain, spinal cord, sympathetic, or any part of the central or peripheral nervous system. We use it to excite muscular contractions whenever the muscles are not so much diseased as to be unable to respond to it, and to produce those strong mechanical effects through which, in great measure, are obtained the remarkable constitutional tonic influences now everywhere so well recognized.

In order to illustrate a point in current differentiation which I regard as of considerable value I may be allowed to instance two cases. The point to which I refer relates to the effects of pressure as indicating the kind of electricity most likely to prove of service in the different forms of pain for which relief is sought. Without attempting to discuss the relation of pain to pathological states or its different forms and locations, I call attention to the well-attested fact that of all innoxious remedies electricity is the most powerful agent in nature for the relief of pain. Not that it never fails, for this it does often enough, but its failures would be far less frequent and its reputation along this line more firmly established if the differential indications for its use were more carefully considered.

It is a common observation that in many forms of pain and so-called neuralgias firm and equal pressure over the affected parts causes no discomfort whatever, and frequently affords marked temporary relief. In other cases the parts are sensitive to all external impressions, and pressure or rubbing decidedly aggravates the existing pain. True neuralgia is undoubtedly, as a rule, represented by the last class of cases, while the former class, in which pressure relieves and in which pain occupies certain areas and runs seemingly in the direction of certain nerves, must be classed among the hysterical and pseudo forms of neuralgia.

In true neuralgia the pain invariably can be definitely mapped out along the line of certain nerve-trunks, and in these cases the galvanic current is almost without exception indicated, and not the faradic. In

the hysterical and false forms of neuralgia, however, the indications for the faradic current are almost as invariable as they are for the use of the galvanic in true neuralgia. I say almost, for we do occasionally find cases of the pseudo and hysterical forms of neuralgia in which the affected parts are not only sensitive to pressure, but also unusually sensitive to the effects of electricity, affording additional proof of the general correctness of the statement that painful parts that are sensitive to pressure indicate the galvanic, and those that are insensitive to pressure call for the faradic current.

Cases of widely diffused and superficial neuralgic pains, with sensitiveness to pressure, as well as those belonging to the true type of neuralgias, are best treated by the galvanic current alone. This practical point in electro-therapeutics is well illustrated by the two following cases, which were treated at the clinic of the New York Post-Graduate Medical School, the histories of which I transcribe with my remarks made to the class. In the case of the first patient there was a statement simply of pain in the head, which began six years before:

"Pain was diffused quite widely over the vertex, but seldom affected the forehead or occipital region, and up to the present time he has been able to find no remedy that has afforded more than temporary relief. His general health is fair, and careful examination has failed to detect anything specially abnormal in the urine. In the morning he is quite comfortable, but about 2 P. M. the pain begins, and continues until he goes to bed, when he is benefited by sleep, as he is also by outdoor exercise, and frequently also by a hearty meal and cold-water applications. When entirely free from pain the part is not more than ordinarily tender, but while suffering the slightest touch is disagreeable, and any form of pressure or rubbing becomes decidedly painful.

"Here, then, is a case where, if electricity is to be used at all, we must decide between its different manifestations. I have not the slightest doubt but that the faradic current would have altogether failed to relieve him, and it might have aggravated his symptoms. The galvanic current, on the contrary, as he will be glad to assure you, has during the few weeks that the applications have been made resulted in a decided mitigation of his symptoms, and we confidently expect complete recovery. I will now treat him by the method of central galvanization. I begin with five milliampères of current, and gradually increase it until twenty are reached—a strength seldom necessary to exceed in these cases. He says that the metallic taste is strongly marked and the saliva flows freely, but there is no pain, because, as you observe, my electrodes are large and soft and applied firmly and with equal pressure. By decreasing the current as gradually and carefully as it was increased all interruptions are avoided, and the treatment concluded without disagreeable flashes of light or shock.

"The second case is a good illustration of the other side of the question. The pains first began to trouble the patient three years ago,

and so severe were they that he gradually formed the morphine habit, taking finally as much as eight and ten grains a day. From this habit, however, he at last succeeded in breaking away, and since August last has not indulged in it. The pain is located in the forehead and temples, being at times most severe on one side, and then again on the other. It comes on two or three times a week, and, unlike the first case, all forms of activity aggravate it. Unlike it, also, firm pressure and rubbing afford grateful relief, and the degree of insensitiveness to electricity (faradism) is quite remarkable.

"You are perhaps aware how exceedingly sensitive the forehead, and indeed all bony prominences, are to the induced current of electricity; but in this case the strength that is applied without discomfort is many times greater than any one in this room could possibly endure.

"The faradic current is as strongly indicated here as was the galvanic in the other case, and I am glad to say that it has been followed thus far by equally good results. I use my hand in applying the faradic current to the head, because no electrode that human skill can devise can equal the hand in flexibility and power of adaptation to uneven and painful areas; and as I now apply it the current is so strong that only long practice enables me to manipulate the parts successfully."

Electricity as a Means of Diagnosis.

Injury to a motor nerve is followed by certain anatomical changes associated with altered function as well as altered electrical reactions. There is always a very definite correspondence between the two, and in the ability to determine from the electrical conditions the histological state of nerve and muscle consists, in the main, the art of electro-diagnosis.

When a motor nerve is divided the muscles which it supplies are immediately paralyzed, and, no longer being in connection with their nutritive centre, the spinal cord, both nerve and muscle undergo pathological changes. Accompanying these changes are marked deviations from the normal electrical reaction of both nerve and muscle. *Immediately* after the section of a nerve there is often a temporary increase of electrical response to both currents when applied to the nerve or the motor-point of the muscle. Subsequently, however, there is a steady decrease in the readiness with which electrical reactions take place, until finally the excitability to both currents is completely abolished. These, it should be observed, are termed *quantitative* changes.

If the applications are made directly to the muscle, and not to the nerve, we find quite a different set of phenomena. The faradic current, applied thus, acts very much as when it is applied to the nerve; not so the galvanic. When the latter is applied directly to the muscle, there is observed an immediate diminution in the readiness of response, but in a comparatively short time an increase of the electric excitability

is developed. This is a sure indication that we still have healthy muscular fibre, but fibre deprived of its nerve-influence.

Soon, however, the muscular fibre itself begins to degenerate, and the galvanic current, instead of being followed by an increased readiness of response, acts upon the muscle less and less effectually, and finally, if regeneration in the nerve-structure does not take place, the galvanic irritability to muscle becomes extinct.

Accompanying this decreasing readiness of response are other changes in the character of the contractions, termed *qualitative*, or, as they have been called by Erb, the reaction of degeneration. If regeneration of the nerve and muscle should occur, galvanic reaction is also re-established, but fails to reach its normal standard for a long time. I have seen a number of cases in which the response of muscle to galvanism remained below the normal standard long after the complete return of voluntary movements and perfect response of nerve to faradism.

A case of facial paralysis that I have recently had illustrates many of the foregoing points. A week subsequent to the attack there was found to be marked diminution of response to both currents. On the tenth day or thereabouts there began to be a progressive increase of response to the galvanic current, but no abnormal reactions indicating degeneration of muscular fibre. These phenomena, however, began to appear at a later period, associated with a gradual decrease of galvanic response, and now neither current, when applied to the nerve, produces the slightest effect, while galvanism directly to the muscle causes only feeble and delayed reactions with currents as strong as can be borne by the patient. These observations illustrate in a very interesting manner the progressive anatomical changes that take place in an injured nerve, and the relations they bear to electrical phenomena.

The diminished reactions to both currents first observed when applied to the nerve indicated that the nerve-tissue itself was structurally altered, but did not necessarily indicate muscular degeneration. There occurred, on the contrary, increase of response to galvanism applied directly to the muscle, indicating that the muscular fibres were still healthy. This increase of reaction is said to be due to the deprivation of the inhibitory action of the paralyzed nerve, as well as the altered nutrition of the muscle itself. The reactions of degeneration which finally appeared, and still exist, together with the quantitative changes or decrease of response to both currents, indicate degeneration of the muscular fibre itself, which may go on to a complete extinction of the electrical reactions. This indicates complete destruction of the muscle. As in the study of auscultation it is necessary to understand the normal action of the heart, so in the study of electro-diagnosis it is necessary to understand the order in which contractions

occur in the healthy nerve and muscle when subjected to the "make and break" of the galvanic current. Bearing in mind that in health the closing contraction is always more vigorous than the opening, whichever pole is used, and that the cathode or negative pole acts more vigorously than the anode or positive pole, it is readily appreciated that there can be but four orders of contractions elicited in health, in the following order:

1st. The cathodal closure contraction, indicated by the formula C.C.C.;

2d. The anodal closure contraction, A.C.C.;

3d. The anodal opening contraction, A.O.C.;

4th. The cathodal opening contraction, C.O.C.

When, therefore, we speak of quantitative changes occurring in the electrical response, we mean simply that this order is changed, the A.C.C. being greater than the C.C.C., or the C.O.C. exceeding the A.O.C. These changes are also referred to as the "reactions of degeneration," and invariably indicate structural disease of muscular as well as of nerve tissue, while quantitative changes indicate degeneration of nerve-tissue only. This is an important point which it is well here to emphasize, for I find there exists a very general misapprehension in regard to it.

Qualitative changes in the electrical reactions are generally, if not always, associated with marked quantitative changes, while quantitative are often entirely independent of qualitative alterations. The one (quantitative) indicates more especially disease of nerve-structure; the other (qualitative) suggests degeneration of muscular tissue.

Such diseases as progressive muscular atrophy, pseudo-hypertrophic muscular paralysis, amyotrophic lateral sclerosis, and bulbar paralysis excellently illustrate degeneration of muscle with healthy nerve. In progressive muscular atrophy, for example, the electrical reactions demonstrate a healthy nerve, but a degenerated muscle. Either current applied to the nerve calls forth normal contractions. The faradic current, applied directly to the muscle, calls forth contractions according to the amount of healthy fibre remaining. The fact that it produces contractions at all demonstrates the integrity of the nerve-fibre, while the qualitative changes that are elicited on the application of the galvanic current to the muscle indicate the extent of the muscular degeneration. Similar phenomena are observed in the other diseases that have been mentioned in connection with progressive muscular atrophy. The diseases, on the other hand, that show healthy muscle, but diseased nerve-tissue, are confined altogether to those of central origin.

These are paralysis from cerebral disease, and with few exceptions all those forms of spinal paralysis in which the gray matter of the

spinal cord is not involved. Therefore, locomotor ataxia, the various forms of multiple sclerosis without trophic changes, and spastic paralysis are seldom, if ever, associated with qualitative changes. Quantitative changes are not infrequently observed in these spinal diseases, as well as in disease from cerebral lesion, but their causation is found in a general excitability due to an irritative lesion, to an absence of inhibitory action, or to atrophy of muscle through disease, and not to actual degeneration. In some nerve-trunk diseases, and also in acute affections of the gray matter of the cord, neither current applied to the nerve calls forth reactions.

Faradism to muscle gives no response, but galvanism to muscle is followed by normal or increased response. This indicates that both the nerve-trunk and its nerve-filaments are diseased, but that the muscle itself is healthy. These phenomena are of course observed only in the very earliest stages of the diseases mentioned, and in the nature of things must as a rule escape observation. Polio-myelitis anterior, on the contrary, whether occurring in the adult or in childhood under the name of infantile paralysis, and also lead palsy, uniformly yield those quantitative and qualitative changes that indicate degeneration of both nerve and muscle.

There are, again, still other forms of paralysis from spinal disease in which the character of the reactions varies widely according to the seat of the lesion. In myelitis, for example, the electrical reactions may be absolutely normal, indicating that the disease is probably confined to the antero-lateral or posterior columns, while in other and the majority of cases there are quantitative and qualitative changes that clearly point to disease of the gray matter of the cord.

An interesting deviation from the ordinary reactions found in diseased nerve and muscle, but one not very frequently met with, I imagine, is where both currents applied to the nerve or the motor-point of the muscle fail to produce any contraction whatever, while either current applied to the muscle directly calls forth reactions even more vigorous than normal. It is perfectly plain that this phenomenon means a diseased nerve-trunk, but a healthy muscle, with healthy intramuscular nerve-branches. As these reactions have been observed only in the very earliest stages of a traumatic injury to a nerve and in rheumatic neuritis, they would necessarily in most cases escape notice.

Methods of Electrical Application.

The main methods of electrization are five in number—viz. 1st. Localized faradization; 2d. Localized galvanization; 3d. General faradization; 4th. Central galvanization; 5th. Franklinization. These are of course subject to infinite variation in the practical details of

their application; but a general description of each may prove sufficient as the foundation-stones on which to build experience.

Localized Faradization.—The art of limiting the excitation of the faradic current to certain organs and tissues is in the main due to Duchenne. He called attention to the fact that electricity could be localized under the skin if moist electrodes were firmly pressed upon the skin. He was led to this observation by the very familiar phenomena that follows the application of the dry electrode or hand to the surface of the body—viz. a crackling sound, but no sensation and no muscular contraction. This is due to the very slight conductivity of the skin. Through moisture, however, its conductivity is increased, and he observed that when wet electrodes were applied the same strength of current excited contractions immediately. This system, simple in its origin and detail as it may seem, has been refined and developed until it has grown into a permanent department of science. To be proficient in its use demands a certain amount of anatomical and physiological knowledge and manual facility; but its successful employment requires neither the dexterity nor care that is exacted by localized galvanization, general faradization, and central galvanization, nor the time and patience demanded by the last two methods. For these reasons localized faradization has been generally adopted by the mass of the profession, to the exclusion of the more advanced processes by which alone we can fully utilize the therapeutic powers of electricity. In carrying out the details of localized faradization the situation of the motor-points should be carefully studied. Ignorance of these points will involve waste of time in searching for them with electrodes in hand, and at the same time add to the annoyance of nervous patients. By placing the negative pole over the motor-point and the positive over the belly of the muscle, we obtain immediately the best possible contractions, whether for therapeutic or diagnostic purposes, with the minimum strength of current.

Localized Galvanization, especially when applied for the relief of pain, is a procedure of much greater delicacy than localized faradization. It was introduced to the profession more especially by Remak in a work *On the Methodical Electrization of Paralyzed Muscles,* by virtue of which he became the founder of a school of electro-therapeutics in Germany, as Duchenne had been in France.

The term "stabile application" is employed when both electrodes are kept in a fixed position. The term "labile application" is employed when one or both electrodes are glided over the surface, without, however, causing any interruption of current sufficient to produce appreciable muscular contractions. When we desire to induce a purely sedative influence, it is of the greatest importance that the galvanic current should not only be free from any distinct interruption,

but that every variation of current-influence, such as follows moving the pole along the skin, should be carefully avoided. At other times, however, it is desirable that our applications should be increasing, by which is meant that the current-strength is augmented with more or less rapidity without removing the electrodes. If the current is thus gradually increased, a much greater power can be borne than if it is suddenly let on in full force with the first closure of the circuit. A current which may produce unbearable pain, or, when applied near the nerve-centres, dizziness and faintness, may be borne without discomfort and with positive advantage if it is gradually increased from the minimum of current-strength.

Applications to the brain, eye, and ear especially, and to the sympathetic, spinal cord, urethra, and to all conditions of great irritation wherever seated, should always be thus gradually increased, and in the same way decreased. With the faradic current the management of these increasing and decreasing currents is very simple; but gradually to increase the galvanic current, especially if no rheostat is at hand, requires very great care.

Most galvanic batteries that are now made have an arrangement that gradually adds to the number of working elements without interrupting the current; but even with the greatest precision of manipulation breaks are apt to occur when least expected or desired, and it is far safer, therefore, to be always provided with some form of rheostat.

Labile or stabile interrupted currents are generally preferred for the galvanization of muscles, while for the galvanization of the head, spinal cord, sympathetic, nerve-tracts, and plexuses stabile continuous currents, either uniform or increasing, are, as a rule, indicated. In addition to their power to produce muscular contractions, labile or stabile interrupted currents cause more marked physical and mechanical effects, while stabile continuous currents, whether uniform or increasing, produce the stronger electrolytic and catalytic action. In applying the galvanic current to the brain it is well to remember that there is less tendency to dizziness if the negative pole is applied first and the circuit closed and opened with the positive pole. There are many special effects of localized electrization, as of general faradization and central galvanization, but the leading and general results of all the methods is improvement in nutrition.

Localized electrization of poorly-nourished and atrophied muscles develops size and increases strength; localized electrization of any organ, such as the uterus, the nutrition of which has become impaired and its size diminished, tends to develop it and to increase its functional activity. In localized electrization these results are of course of a local nature; yet, owing to the fact that absolute localization is

impossible, we not infrequently observe effects extending far beyond the parts actually enclosed in the circuit. By reflex action also we obtain remote effects which are either desirable or undesirable according to the demands of the case in hand.

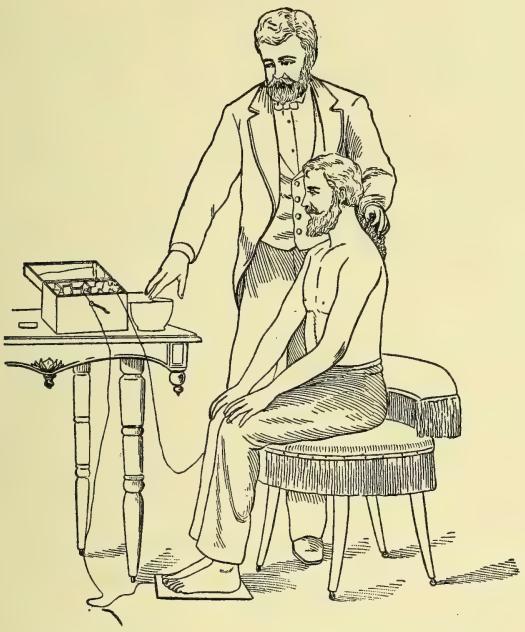
Galvanization of the spine, and even of the extremities, may in certain irritable conditions excite the characteristic metallic taste. Galvanization, or even faradization, of remote and limited areas sometimes relieves pain, induces sleep, and increases the menstrual and other discharges through reflex influences alone. The effects of all local as well as general applications vary according to the length of the séances. The effect of the faradic current, when first applied by means of moistened electrodes, is to cause a tingling sensation, more noticeable at the negative than at the positive pole. In a short time the sensation becomes less and less marked, and a sort of anæsthesia is produced, enabling the patient to endure an increasing strength of current with no discomfort. The galvanic current, unless it be quite strong or directed over a motor-point, at first usually causes little if any sensation. In a short time, however, a slight burning sensation is experienced, rather more keenly felt at the negative pole. This sensation rapidly increases in acuteness until it may become absolutely unendurable; for, unlike the faradic current, the galvanic has not the same tendency to produce anæsthesia. There are two causes which probably account for this increase of pain, as well as of increased readiness of muscular contractions. The first is the fact that the conductivity of the skin becomes increased, not only through the moisture from the electrodes, but also through the greater activity of the circulation in the skin under the electrodes; and the second is the increased nerve-sensitiveness resulting from the stimulating effects of the current.

General Faradization.—In the administration of general faradization we employ, as is evident from its nomenclature, the faradic current alone. Its object is to bring the external portions of the body from the head to the feet, and as far as possible the internal tissues and organs also, under the influence of the current. The galvanic current may be used in this way as well, but it is so rarely indicated that I have not included it in the enumeration of the methods of application. Its chemical and reflex influences are so potent that, excepting in cases of rare and remarkable insusceptibility to influences of all kinds, its effects would prove harmful rather than beneficial. It is very seldom indeed that a case is seen in which general electrization is indicated—that the faradic current is not sufficiently powerful, either directly or reflexly, to excite the physiological activities.

In order to bring the whole body thoroughly under the influence of the faradic current the feet of the patient should be placed upon a copper plate, to which the negative pole is attached (Fig. 59). The soles

of the feet are not at all sensitive to the current, but if the patient is especially nervous or susceptible the feeling of constriction that is experienced in the ankles as the current passes, and the occasional contraction of the flexors and extensors may become disagreeable and even hurtful.

FIG. 59.



General Faradization : application to the spine.

In this case it will be better to apply the negative pole by means of a broad, soft sponge near the coccyx.

The positive electrode may be either natural or artificial. The hand is the natural electrode, and those who are able to bear the requisite strength of current through their own persons, and are willing to subject themselves to the fatigue which follows its frequent use in this way, will find it unrivalled by any other form of electrode. It is not absolutely necessary that the hand be used, but it can be readily understood that no artificial electrode that human skill can devise can equal the hand in its flexibility and the readiness and completeness of its adaptation to every inequality of surface. In all applications to the head, eyes, and face, and in the more general treatment of acutely susceptible patients and hysterical women, one will fail in numberless ways to obtain the same results by any form of artificial electrode. Ordinarily, however, when the applications are made along the course of the spine, and over the abdomen and lower limbs, the strength of the current necessary is too powerful to be passed through the arms

of any operator, and, fortunately, artificial electrodes answer here as good a purpose as the hand.

In submitting a patient to general faradization the operation should be with some regard to order. In the first place, the hair being thoroughly wet, the hand is passed with firm pressure over the entire surface of the head. In treating the forehead, which is far more sensitive to the current than any other portion of the body, the operator should first press his moistened hand firmly over the part, and then make the connection with his other hand on the sponge of the positive pole. The strength of the current when applied to sensitive parts of the body can be sufficiently regulated by increasing or decreasing the grasp of the positive pole held by the right hand. An application of the faradic current to the head in many forms of neuralgia, nervous headache, and insomnia, if properly given, is capable of affording instant and most grateful relief.

There are few, however, who administer it with any degree of precision or skill, and as a consequence we witness aggravation instead of relief of pain. The slightest concentration of current in such situations as the forehead is capable of exciting pain even in the normal condition, while a proper diffusion over a broad surface, with equal and gentle pressure, affords a sensation as agreeable as it is curative.

The back part of the head and upper portion of the spine (cilio-spinal centre) will usually bear powerful applications; and it is an interesting and important fact that the applications to this centre will produce far greater tonic effects than when the pole is applied to any one other portion of the body. Care should be taken to avoid all bony prominences, since slight currents in these regions give pain. Hence over the scapula, clavicle, sternum, crest of the ilium, tibia, etc., care should be exercised in the moderation of the current. Let the first applications be tentative.

Experience will soon teach that there is no remedy to the effects of which there is such a varying degree of susceptibility as to this. A glance will not suffice, and frequently careful examination will fail to give information as to the proper strength and thoroughness of the treatment that should be first attempted. Not until the patient is submitted to a careful electrical test can we be sure that what we might consider very gentle treatment will not be too severe for the case in hand. As in the administration of localized galvanization, the current may be uniform or increasing. When the electrode is on the head, cilio-spinal centre, epigastric region, or pressed firmly on the various motor-points and nerve-plexuses, the current should be increasing. To make the applications successful, not only in the ultimate good, but also in that the patient experiences no subsequent weariness, soreness of the muscles, or vague but distressing nervous feelings, requires far more

care and experience than is generally supposed. On the part of the operator is demanded a certain degree of mechanical dexterity, entire familiarity with the instrument required, a complete knowledge of electro-therapeutical anatomy, a personal acquaintance with the sensations and behavior of all portions of the body under the different electrical currents, and close and patient study of the diseases and morbid conditions in which they are indicated.

General faradization is, to me, absolutely indispensable in the practice of electro-therapeutics. Beginning with the method many years ago, and at first confining my manipulations in electricity almost exclusively to it, I have not to this day seen cause to abandon its practice. There is no one tonic influence in medicine comparable to it in power; there is none to which can be accorded such a wide range of application; I can only account for its neglect on the part of those who profess proficiency in electro-therapeutics because of the time and labor requisite for its successful utilization, and the unwillingness of the physician to subject himself or his patient to trouble.

Central Galvanization.—By central galvanization we understand that method of treatment by which the whole central nervous system, brain, sympathetic nerves, and spinal cord, are brought under the influence of the galvanic current (Fig. 60). To accomplish this, one pole, usually the negative, is placed over the solar plexus, while the other is firmly pressed on the top of the head and gradually passed over the occiput, along the inner border of the sterno-cleido-mastoid muscle, from the mastoid fossa to the sternum, and from the cilio-spinal centre down the entire length of the spine. For this method, which we first introduced and described a number of years since, is claimed a distinct and important position. The different applications to the head and neck which have been variously used since the time of Remak are simply forms of localized electrization; but in central galvanization, as is observed, the poles are so placed that the whole central nervous system is brought under the influence of one pole—usually the positive—without disturbing the other.

FIG. 60.



Central Galvanization.

One reason that has been offered for rejecting central galvanization is the fear that its relations to electro-physiological laws cannot be fully explained. It is asserted that a remedy in order to be indicated in any special disease must have certain well-known physiological activities that directly meet or counteract the observed pathological conditions. To a certain extent this is true. For the relief of a dry skin and high pulse we resort to diaphoretics and arterial sedatives. To reduce the volume of blood in the brain we have bromide of potassium, and so on; but, on the other hand, can any one tell us minutely and satisfactorily why quinine has a controlling influence over the manifestations of malarial poison, why iodide of potassium tends to eradicate the syphilitic poison, or why opium causes sleep? And yet quinine is indicated in intermittent fever, iodide of potassium in syphilis, and opium in insomnia. That we cannot accurately localize the action of the current in limited areas of the brain has already been stated; but that external applications of the galvanic current penetrate directly to and appreciably affect it is thoroughly established, and the sedative and tonic effects that follow are well known to every one who has intelligently and thoroughly tested the method.

Central galvanization demands a far greater familiarity with the physics of the constant current, and with both functional and structural derangements of the central nervous system, than is possessed by many who essay its use. If there is any one therapeutical process in the whole range of practical medicine that more than another defeats its own legitimate ends through careless and ill-directed or ignorant applications, it is this. As a matter of experiment we submit a person in robust health and with no marked nervous susceptibility to central galvanization. If the current is gradually increased and as gradually decreased, without interruptions, few if any unpleasant sensations are perceived. The metallic taste is decided, the head experiences a sensation of fulness, and if the experiment be prolonged or the electrodes small, itching and heat will be experienced at either pole, and on the head (the seat of the anode) slight pain of a dull aching character may possibly be felt. A second person, of increased nervous susceptibility, will experience an exaggeration of all these phenomena, and subsequently may suffer from severe headache. Because of the symmetrical influence which the galvanic current, by the method of central galvanization, exerts on the brain, little if any dizziness is perceived by even the most sensitive patients; if, however, the current be passed transversely through the head, the so-called falsification of the muscular sense that results from an unsymmetrical stimulation (one pole affecting the right and the other the left hemisphere) is the occasion of immediate and intense vertigo.

In thus transversely galvanizing the brain the hemispheres are dif-

ferently influenced, and the result is a disturbance of the equilibrium. In conditions of health this dizziness, as a rule, passes off immediately on the removal of the electrodes, and is attended by no harmful results. In certain pathological conditions, however, and signally so when such conditions are associated with those peculiarly impressible nervous organizations that are so familiar, transverse galvanization of the brain is a highly culpable procedure. Let it be clearly understood, then, that in most cases this method should be avoided.

I might cite not a few suggestive cases, and not alone in my own experience, illustrative of the importance of this law; but it will perhaps suffice if I simply indicate a few guiding propositions. And, first, there is a certain class of patients, that I have just alluded to as being peculiarly impressible, who will in no degree be benefited by passing the current transversely through the brain; on the contrary, if there is mental or physical derangement from any cause, such application immediately aggravates the existing disturbance. In many instances there is no outward indication of any such susceptibility, and very frequently the most careful examination will fail to elicit a suspicion of any unusual relation of the nervous system to electrical stimulation. It is only when they are subjected to the test of actual treatment that idiosyncrasies are manifested that would not be distinctly revealed by any other method. In two exceptional cases, for example, of which I have records a current of comparatively feeble tension caused an astonishing excitation of all the nerves of special sense. Sight, taste, smell, and hearing were perverted and exalted; and that these evidences of excitation were not the result of fancy I thoroughly satisfied myself by unerring tests. In these cases, as in a number of others that enter as factors into the experience that guides these observations, the after-effects were only less unpleasant than the primary, and were disagreeably persistent.

Now, observe the effects of applications by the method of central galvanization in the same patients. The same tension of current causes a decided metallic taste (but no vertigo and no ringing in the ears), with a slight feeling of fulness about the head; and persistence in this form of treatment resulted in decided relief. In consideration, therefore, of these facts we should be ever watchful for these susceptible cases, and to avoid errors of judgment that might prove unfortunate we should not presume even on the most extended experience, but should in the beginning pursue a tentative course.

In the second place, we have in cerebral effusion and softening, and especially in cerebral congestion, conditions that call for care in any method of galvanizing the nerve-centres. In old apoplectic cases transverse galvanization of the head has often been used with no unpleasant results. There can be no doubt, however, that it might in many

instances prove exceedingly hazardous, and I have even seen unmistakable evidence of the ill effects (in producing dizziness and nausea) of an injudicious application of localized faradization in the neighborhood of the base of the brain and in the mastoid fossa. It is in the consideration of the symptoms of cerebral congestion, however, that we see most clearly the importance of rightly selecting our methods of electrical treatment. To give any direction to the currents excepting a longitudinal one (by which I mean from the summit of the head downward or from forehead to occiput) is, I believe, not only unphysiological, but contrary to the teachings of extended and carefully recorded experience.

In this connection, and especially with reference to central galvanization, an exceedingly important practical point arises concerning polar influence and current direction. Is the position of the poles or the direction of the current the more important factor in the production of therapeutical and purely physiological effects? The French school, and notably Legros and Onimus, denied the efficacy of polar influence in exciting physiological phenomena, ascribing them chiefly to current direction. They ascribed anelectrotonic effects to electrolytic action and to the induction of currents of polarization.

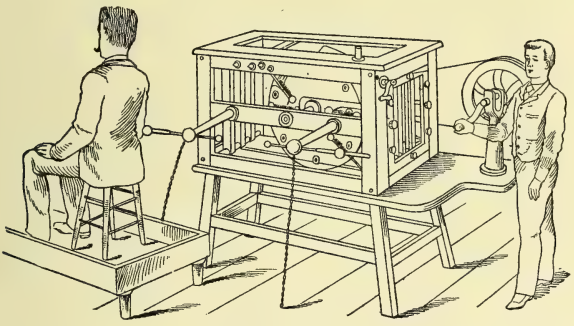
The contraction laws of Pflüger render it quite possible that in the electrical stimulation of a given nerve-piece the polar influence has more to do with the resultant physiological effects than the direction of the current; and according to this theory the relative position of the poles in central galvanization (anode above and cathode below) would seem, on physiological grounds alone, to be chiefly indicated for the relief of symptoms of central origin. Experience, at all events, strongly confirms its propriety.

It is very certain that in many conditions, and especially in true neuralgia and spinal irritation, therapeutic effects vary according to the position of the poles. In central galvanization few facts are better established, to my mind, than that certain conditions, such as cerebral congestion and forms of hysteria, may be injured rather than benefited by what are termed ascending currents, but whether the ill effects are due to current direction or polar action I am not prepared to say.

Franklinization.—By franklinization is meant the application to the body of franklinic or static electricity. The simplest form of treatment is by insulation (Fig. 61). In this method the patient is placed upon an insulating stool or table and connected with the conductors of either side according as a positive or a negative charge is desired. This silent reception of the electricity, and its silent and more gradual discharge from the body to the surrounding atmosphere, produce in most persons very pleasant effects. The hair of the head rises up, accompanied by an agreeable sensation, as if the wind were

playing gently around. The pulse may be slightly accelerated and the face become flushed, while after a time it is occasionally observed that a slight but general perspiration appears. This condition may fre-

FIG. 61.

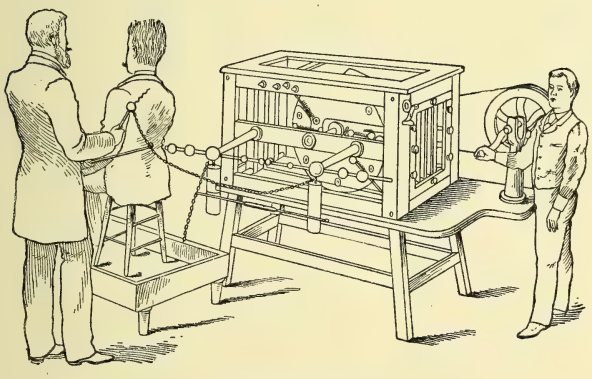


Static insulation.

quently be kept up with advantage for twenty minutes or so, until an agreeable feeling of drowsiness is experienced.

In the treatment by sparks or spray (Fig. 62) the patient is first

FIG. 62.

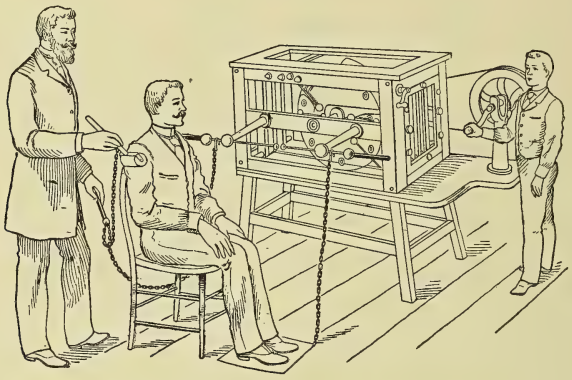


The direct spark.

put in the condition of insulation just described. Sparks can then be drawn from any portion of the body by the near approach of a conducting substance. Brass balls of various sizes, mounted on glass handles held by the operator, connected by a brass chain with the ground, or, better still, with the nearest gas- or water-pipe, are usually employed. As a substitute for general faradization, although by no means so generally effective and far less agreeable, the metallic roller may be used (Fig. 63). It acts reflexly and excites the cutaneous nerves most decidedly. When the roller is used upon the bare skin the conduction is so perfect that no sensation is appreciated. It is only when

the clothing intervenes that the peculiar pricking sensation is observed. It is needless to say that to obtain the best therapeutic effects of the roller it should be applied over the clothing. The electric wind, so

FIG. 63.

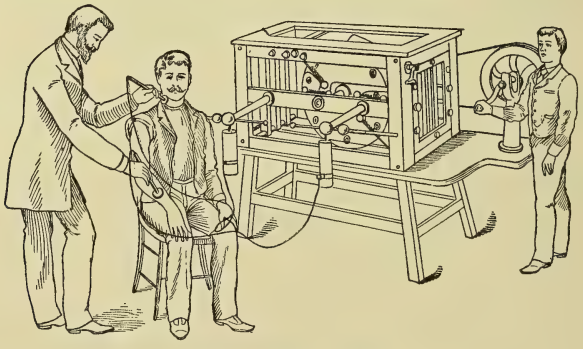


Treatment of metallic roller (general franklinization).

called, following the use of the pointed electrode, is due to the agitation of the air between it and the person treated. The discharge is silent and the effect exceedingly agreeable and refreshing.

Treatment by Shock.—This is a violent method, and not usually called for. It is produced by bringing the body, or that portion of it on which we wish to operate, in the circuit between the outer and inner coating of the Leyden-jar attachment. In addition, a static induction current, first described by Dr. W. J. Morton[1] of New York, can be obtained (Fig. 64). This has been suggested as a substitute for faradic

FIG. 64.



Static induced current.

electricity. It is claimed for this current that it produces maximum

[1] For an exhaustive consideration of the franklinic interrupted current see the New York *Medical Record*, Jan. 24, 1891.

muscular contractions with a minimum amount of pain, and that the response is quicker than that from the faradic current. As for the first claim, it is difficult to see how it can be determined, since the ordinary faradic current, from the single-coil apparatus especially, need seldom call forth pain in the production of muscular contractions. The change in the apparatus for the production of this current is quickly and easily effected, and for the purposes of localized electrization is most valuable. For general faradization, however, I can quite confidently assert that it is inferior to the current produced by the best faradic apparatus. That it possesses certain advantages, however, over the faradic current cannot be denied. Its voltage is enormous, and the alternations of each spark so rapid (millions per second) as necessarily to give it precedence in many respects over the ordinary induction current.

In order to obtain this current it is necessary to hang a pair of Leyden jars, as seen in the illustration, upon the arms of the machine. As the strength of the current is modified by the size of the jars, it is well to have several sets of different sizes. Rheophores to which ordinary sponge electrodes are attached are joined to the hooks that rest upon the outer coating of the jars. The strength of the current is in direct proportion to the distance apart of the two knobs of the discharging rods. These, therefore, should approximate closely at first, and be separated gradually as a stronger influence is desired.

The absolute value of franklinic electricity as a therapeutic agent is, without question, very great. Its relative value cannot be estimated with the same readiness, since conclusions on this point render it necessary to compare its effects with those of dynamic electricity. Any arguments, therefore, in the direction of showing that franklinic electricity has greater claims upon us as a remedy than has been generally believed must, of necessity, be quite valueless unless they are based upon long and thorough use of the different forms of dynamic electricity, especially by the methods of general faradization and central galvanization. The difficulty of obtaining reliable and exact information in regard to this matter will undoubtedly lie in the fact that in the future as in the past clinical reports will be too often given by those who have had no systematized or adequate experience in the use of dynamic electricity.

Sedative and tonic effects of a very interesting character are undoubtedly obtained through franklinization, but these effects are hardly equal in variety or degree to those that follow the careful and thorough use of dynamic electricity by the methods above mentioned. None the less, however, do we hail the recent revival of this neglected department of electro-therapeutics, not only because in certain conditions it may possess some advantages, but because, through peculiar idiosyn-

crasies, it is sometimes better borne than the other forms. It must not be forgotten, however, that, as a rule, general faradization is far more agreeable than treatment by sparks, however carefully given. Those who assert to the contrary do so through lack of experience or skill in the general method of administering faradism.

Of all the approved methods of using electricity, franklinization has the advantage of requiring the least skill and experience in its administration, and the disadvantage of necessitating apparatuses that are cumbersome, expensive, and not in the same degree reliable as the instruments for the generation of dynamic electricity. A still further advantage lies in the fact that little if any disrobing is necessary, since the drawing of sparks and the general stimulation of the surface are accomplished through ordinary clothing.

Another important reason for the use of franklinic electricity—and one which, to my gratification, I have thoroughly tested—is its occasional value in supplementing and reinforcing the constitutional tonic effects of general faradization.

It is one of the familiar things in medicine that a remedy which at first acts most effectually may, after a time, cease to have the desired effect. If, now, we substitute a remedy of the same class, even though it be inferior, further benefit often follows, and upon returning to the original treatment it acts with renewed vigor. The same principle holds good in regard to the dynamic and static forms of electricity. Occasionally cases of nervous exhaustion, as well as other forms of disease, after improving up to a certain point under the influence of galvanism or faradism, hang fire, as it were; but by submitting the patient to the action of franklinization a new impulse seems to be given. In this way, one treatment supplementing and reinforcing the other, results are obtained far more satisfactory than could possibly follow the exclusive use of general or localized faradization, central galvanization, or franklinization.

To determine the exact therapeutic status of franklinic electricity we need still to experiment and observe. A considerable experience, however, in its use would lead me to thus formulate what I believe to be the truth in regard to this matter:

First.—As previously asserted, tonic and sedative effects of a very decided character can be obtained from franklinization, by either insulation or sparks: these effects, however, are equal neither in variety nor degree, taking the cases as we find them, to the effects of dynamic electricity properly and thoroughly used after the methods of general faradization and central galvanization. As supplementing these methods, however, when in protracted cases they seem in a measure to have lost their effects, we have abundant testimony of its value.

Second.—It has long been known that many temperaments and

conditions of disease would bear faradization or galvanization readily, and yet shrink from electrization from sparks, while the reverse was not so evident. At the present time I have under my care two women, members of the same family both suffering from analogous affections. One regards general faradization as exceedingly agreeable, and is benefited by it, but shrinks from the treatment by sparks, and even dislikes the milder method of insulation, and complains of disagreeable sensations subsequently; the other much prefers the most positive treatment by franklinization.

Third.—In the enlarged joints of subacute and chronic rheumatism the treatment by sparks is frequently more efficacious than either faradization or galvanization. In the acuter stages of this disease, however, the descending faradic current affords greater relief. In old contractures and cutaneous anæsthesia franklinization may possibly possess some advantage.

Fourth.—As compared with the faradic current alone, franklinic electricity has undoubtedly some advantages in the treatment of some forms of neuralgia, but as compared with both the galvanic and faradic currents, I have been able to demonstrate no such advantage. Galvanism alone is superior to franklinism for the relief of pain, and yet the latter occasionally aids the former method not a little, on the same principle that it may be often used to supplement the use of dynamic electricity for the production of tonic and sedative effects.

Fifth.—In electro-diagnosis franklinic electricity (excepting the static induction current) is of but limited value, those qualitative and quantitative changes which are so important as indicating structural degeneration being satisfactorily made evident only through the action of the two forms of dynamic electricity. In electro-surgery also franklinic electricity is of but little value.

Electricity in Nervous Diseases.

In studying the physiological activities of electricity we are irresistibly led to the conclusion that its therapeutical action must be more especially in the direction of the relief and cure of nervous diseases. Experience thoroughly confirms this conclusion, and therefore he who makes much use of electricity in medicine will necessarily carefully study the neuroses. Much fault has been found with electricity because it fails to cure the graver forms of organic diseases of the nervous system; but it may be asked, Is there any therapeutic agent that will do this? As a rule, we use electricity in this class of affections for its symptomatic effects, and by relieving pain, paralysis, spasm, anæsthesia, and a variety of other symptoms much good is accomplished.

Electricity is essentially a stimulant, an exciter of living tissue; and whether the excellent results that follow its use in deep-seated struc-

tural diseases are due to its direct influence upon the diseased parts or to the peripheral impressions that it registers makes but little difference. Limited, therefore, as its value is in the graver forms of structural disease of the central and peripheral nervous system, it not infrequently acts with extraordinary efficiency in some of these cases, and gives rise to expectations in succeeding cases that are too often far from being fulfilled.

Electricity, however, has wrought its best results in neither central nor peripheral nerve-lesions, but in the variety of nervous disease rather that in our ignorance we have termed "functional."

Because we do not understand the pathology of functional neurasthenic disease, and are still unable to appreciate the errors of nutrition that undoubtedly underlie all these cases, it is no reason why we should not persist in the use of a remedy that has been of such splendid service in their relief. It has been said by Erb that we might as well do away with the bromides and arsenic in functional nervous diseases because we do not understand the theory of their action, as to abandon electricity because of our ignorance of the laws underlying its influence.

Neurasthenia.[1]—One of the most persistent as well as distressing forms of functional nervous disease is neurasthenia. It is claimed by some to be wanting in distinctive features and unworthy a place in the nomenclature of special diseases. Gowers in his great work *On Nervous Diseases* gives to it but a few lines, and most other authors allude to it briefly if at all. And yet the varying and varied forms of symptoms that so persistently group and regroup themselves in the multitudes who are so often told that they have no disease must mean something. These patients do not get well by being told that there is nothing the matter with them. Stereotyped tonic medicinal treatment, as a rule, does little good in these cases, and the effort to cure by favorably influencing the morale accomplishes about as little good in such conditions as it would in any case of true malaria.

One reason why neurasthenia has been so long neglected and is so little understood is that the symptoms are in some instances so subtile, illusory, and difficult of analysis and classification. One who has never seen and carefully examined a large number of cases of this disease would not believe it possible that it could manifest itself in so many different ways. No one example of neurasthenia illustrates more than a very small fraction of the great army of symptoms that has been observed in connection with this disease; and it is for this reason that so many have expressed doubts as to the propriety of any such formulation as neurasthenia.

[1] For a more extended discussion of this interesting subject the reader is referred to *A Treatise on Neurasthenia*, by Geo. M. Beard, M. D., edited with notes and additions by A. D. Rockwell, M. D. E. B. Treat, Publisher, N. Y.

Various forms of head-pain, noises in the ear, atonic voice, deficient mental control, hopelessness, morbid fears, and a host of other symptoms are readily enumerated as helping to make up the characteristics of its various types. These patients are also marvellously timid, and will delay for weeks and months before summoning sufficient courage to consult a physician and relate their woes. Now, in my own experience—and I think as well in the experience of every one who has given close practical attention to this matter—electricity not only greatly aids the action of other remedial agents, but it not infrequently cures where every other reasonable form of medication has failed.

While neurasthenia—a purely functional disease of the nervous system, a condition of profound impoverishment of the nervous force—is so often conquered by the judicious application of electricity, there is another set of symptoms that is very commonly mistaken for neurasthenia for which electricity is by no means so efficient a remedy. These symptoms depend upon a lithæmic condition of the system—faults of assimilation that are so readily mistaken for neurasthenia that very radical errors of treatment result. It might be suggested that the presence of uric acid in the urine ought to be a sufficient diagnostic sign, but uric acid is found in neurasthenic patients and is not at all times found in the lithæmic.

According to my own experience, one of the most common and distinctive points of differential diagnosis between lithæmia and neurasthenia is the difference in the character of the mental phenomena. Both the lithæmic and the neurasthenic suffer from mental depression and a profound sense of misery, more marked indeed in the former than in the latter condition. While, however, the neurasthenic may suffer from the deepest melancholy and imagine himself heir to a thousand ills, he becomes the victim, as a rule, of no such irritability and unreasonable outbursts of temper as the man whose brain is actually poisoned by the imperfectly transformed products of digestion. The neurasthenic may be at times extremely irritable, but this irritability is more passive than active, and any ebullition of angry feeling is quite evanescent. His demeanor is, as a rule, quiet, and there is but little manifest tendency to make those dependent upon him miserable by his words and actions. The touchy mood of the lithæmic, on the contrary, may last for days or weeks. It is due to actual toxæmia, is often if not generally accompanied by obstinate constipation, and may be relieved completely by the action of a cholagogue cathartic.

In neurasthenia, again, cold hands and feet are not by any means the rule, but in intestinal and liver derangements the nitrogenized wastes circulating in the blood cause, by their irritation, tonic spasm of the arterioles, resulting in the cold hands and feet so bitterly complained of by the sufferers from lithæmia. The condition of the

tongue is an important diagnostic aid. In lithæmia it is coated far more frequently and to a greater extent than in neurasthenia, but in some cases of lithæmia the tongue is but slightly affected. It may appear at first sight perfectly normal, and it is only when looked at carefully from the side that an unnatural brownish color is observed. It is in such cases as this that mistakes in diagnosis are frequently made. As regards the pulse, it may be said that in lithæmia it is slow rather than fast, and in neurasthenia fast rather than slow. In neurasthenia the oxalates are frequently found in abundance, while in lithæmia the oxalates are not usual.

These cases of lithæmia, when mistaken for neurasthenia, as is not infrequently the case, and treated by electricity, yield most unsatisfactory results, and their points of differential diagnosis cannot be too carefully studied. The neurasthenic patient, on the contrary, will almost invariably receive benefit more or less pronounced by rightly adapting methods of electrical treatment to his condition. General faradization, central galvanization, and static electricity have all been found to be serviceable, but in different degree and under different conditions.

There is certainly no absolute standard of differentiation in the use of the various forms of electricity, but in those cases in which morbid fears predominate central galvanization or simple galvanization of the brain are especially indicated. With these symptoms we have, mostly, cerebrasthenia or brain-exhaustion, and under the influence of this exhausted condition the emotional nature overcomes reason and will. The results of galvanization of the brain do not perhaps show immediately, but little by little beneficial effects are observed, leading up in many instances to complete recovery.

Neuralgia.—Electricity is of the most decided value in the treatment of neuralgia. While failures follow the most skilful manipulations, and exacerbations of pain not infrequently result from careless and ill-directed applications, it is safe to say that the great majority of cases of neuralgia, not dependent on serious organic lesions, receive more or less benefit from proper electrical treatment, and in many cases the distressing pains dependent on central structural changes are also very decidedly alleviated. The relief of pain is one of the prime functions of medicine; and the question, therefore, as to the form of current best adapted for that purpose is of much importance. There can be no question that galvanism has a wider range in this direction than faradism; yet in consideration that the latter has been very much ignored it seems necessary to say a word in its defence. My experience will not allow me to doubt that faradism is not only invaluable in many forms of pain, but relieves in certain conditions in which galvanism is not only useless, but worse than useless, since it serves

only to increase the existing distress. When, then, a case of neuralgia presents itself for electrical treatment two questions at once arise: First, What form of current is indicated? Second, What method of application?

True neuralgia, as defined by Anstie, is, without doubt, most successfully treated by galvanism, while hysterical neuralgia and the so-called pseudo-neuralgia, which are simply forms of pain occupying certain areas and running seemingly in the direction of certain nerves, yield most readily to faradism. More specifically, the effects of pressure in the various forms of neuralgia are exceedingly useful as guiding symptoms, indicating the proper current. I do not by any means lay it down as a universal law, but it will certainly be found that in the great majority of cases of neuralgia when firm pressure over the affected nerves aggravates the pain, the galvanic current is indicated, while the faradic current has the greater power to relieve when such pressure does not cause an increase of pain.

In the class of cases sometimes called hysterical hyperæsthesia it is well known that firm and prolonged pressure affords marked relief, while pressure superficially or lightly applied increases the pain. The faradic current is here infinitely superior to the galvanic.

In rare cases of excessive pain associated with anæsthesia—a condition which I have encountered in not a few instances—strong and coarse (slow intermittences) currents of faradism are of positive service. Neuralgia of the scalp is sometimes of this kind, and in these cases currents that would prostrate a strong well man are found to be painless and curative.

The revulsive method of treatment by the faradic current consists in faradizing the skin. This is accomplished either by applying the solid metallic electrode or the metallic brush.

The physiological action of the good results that have been known to follow this harsh and painful method of treatment is thus explained: "Electrization of the sensitive nerves determines a non-active flow of blood, and, as neuralgias are usually accompanied by modification in the capillary circulation, it follows that the augmentation and acceleration of the flow of blood may lead to the removal of the painful symptoms."

It should not be forgotten that many neuralgias are developed along with diseases that are constitutional. The neurasthenic and hysterical patients and those suffering from other constitutional anomalies are frequently the victims of severe local neuralgias. In these cases it is useless to rely on any form of local treatment, and general faradization and central galvanization often act admirably in relieving the local pains. In neuralgia, perhaps as much as in any symptom of disease with which we have to deal, the electrical treatment should at first be tenta-

tive. In the beginning mild currents only should be attempted. If the faradic current is used, and the part affected is any portion of the scalp, forehead, face, or neck, the use of the hand as an electrode is far more agreeable to the patient, and is attended with better results than with any form of artificial electrode.

In those forms of neuralgia that are symptomatic in character—those that are associated with diseases of the brain and spinal cord—severe peripheral nerve-lesions, and especially in that form of facial neuralgia known as tic-douloureux, electricity is of doubtful value, or at least is only palliative in its effects. In idiopathic neuralgias, however, in those depending upon rheumatism and neuritis, anæmia and neurasthenia, favorable results may be hoped for.

So far as the direction of the current is concerned in the treatment of the various forms of neuralgia, I am persuaded that on the whole descending currents are preferable to ascending, and, as to polar effects, the positive pole is, in my experience, superior to the negative in its generally calming effects.

Chorea.—I know of no disease in which there are stronger indications for the use of electricity than cases of chorea that have assumed a chronic form. As is well known, the majority of cases occurring in children recover either spontaneously if proper care is exercised, or through the administration of some nerve tonic; and the test of the obstinacy with which this disease will resist treatment is not so much the severity of the choreic disturbance as the length of time it has continued. We may find a simple twitching of the corner of the mouth, that has lasted for years, entirely incurable; while the most violent paroxysms, associated with frothing at the mouth and inability to articulate, may disappear in a few weeks. It is the readiness with which the ordinary case of chorea tends to recover, quite as much as the efficiency of remedies, that has given such repute in this condition to various medicines, such as iron, zinc, arsenic, and strychnine. The surprising lack of unanimity of opinion concerning the treatment of the disease confirms, more than anything else, this belief in its general tendency to recover. When, however, a case (be the movements general or local) has continued without amelioration for several months, it may be considered chronic, and will be more or less difficult to cure. In such a case I regard electricity in some form far superior to any and all other methods of treatment. The two methods that have in my hands been most efficacious are general faradization and central galvanization. While the ascending galvanic current is to be preferred in the treatment of chorea located in a single muscle or in a group of muscles, I very confidently assert that general faradization is far more efficacious when the disturbances are at all general. If the applications

are skilfully made, they will act both as a tonic and as a sedative to allay irritability and induce sleep.

Epilepsy.—That electricity is of some value in the treatment of epilepsy I have for a long time believed, and while my observations in this direction do not enable me to assert the exact measure of benefit that we may hope to derive from its use, either alone or in conjunction with approved methods of treatment, they may perhaps throw some light on the subject, or at least awaken an interest that may lead to a more extended experience as well as to a greater accuracy of observation. I wish to say, first, that in many instances in patients who have been submitted to central galvanization—galvanization of the sympathetic—or to general faradization, a profound tendency to drowsiness has been observed. In some cases sound sleep has for a few moments been induced with the subject in an upright position while receiving the current through the brain. I recall one patient under treatment by central galvanization who was repeatedly put to sleep within a minute after the beginning of the application.

Accepting the theory that a state of cerebral anæmia predisposes to sleep, it is not very difficult to believe that the feeling of drowsiness that so often follows central galvanization, and even general faradization when specially directed to the cervical ganglion, is due to the direct action of the current on the vaso-motor nerves.

It seems hardly necessary at this date to attempt a detailed argument in proof of the very decided action of electricity in any of its manifestations on the arterial circulation.

The well-known effects of direct applications to the sympathetic of the living animal, the results following external applications to the sympathetic observed through the ophthalmoscope and by means of the sphygmograph, and other physiological experiments, have long attested this power of the current.

Among experiments are those of O. Tschetschott[1] and Przewaski,[2] who have investigated the action of galvanization of the sympathetic. The latter found that a lowering of temperature of one side of the face occurs upon faradization of the corresponding ganglia, the decline of temperature ranging from 0.5° to 1.75° Cent., according to the length of the application. In the same way he found that faradization of the ulnar nerve is followed by a decrease of from 0.7° to 2.53° Cent. in temperature in the region between the third and fourth fingers supplied by this nerve. Tschetschott's results are similar.

I have lately had under treatment a patient who has been under the care both of the late Dr. Peaslee and of Dr. Janvrin, and who illustrates, better than any case I ever saw, this control that electricity has

[1] Abstracted in the *St. Petersb. med. Wochenschr.*, Oct., 1876.

[2] *Deutsche med. Wochenschrift*, No. 43.

over the circulation. For several years the patient has been a great invalid from uterine congestion and displacement, and, although now much better of her local troubles, suffers night and day from excessive action of the heart. This activity is altogether functional in character, and in a measure probably dependent on reflex influences, for increase of local pain invariably accelerates the pulse. The pulse is usually between 95 and 120, but it frequently rises as high as 160. When at the latter point an application of general faradization invariably reduces the pulse from 40 to 50, and sometimes 60, beats. When no higher than 125 to the minute, a similar application reduces the number about 30, and when the pulse is beating with its usual frequency, say 95 to a minute, the treatment brings it down from 5 to 10 beats. I have tested this case thoroughly and carefully, and find that no local applications of either the galvanic or faradic currents will give as satisfactory results as general faradization. It is needless to say that the relief following such application is considerable, and the tendency to this unusual excitation seems to be growing less and less.

A case that suggested a certain similarity between the action of bromide of potassium and electricity occurred in the person of a lad aged twelve years. The case was one of *petit mal*, and for two years the attacks occurred from six to ten times a day. In ten-grain doses bromide of potassium reduced the paroxysms to one, two, or three in the twenty-four hours. This improvement continued for a month, when, notwithstanding the increased doses of the bromide, the attacks gradually increased in frequency. General faradization, with galvanization of the sympathetic, was then resorted to, and the results that followed were substantially the same as those obtained from the bromide. The epileptic seizures were reduced to from one to three a day, but after a few weeks they returned with their usual frequency. Subsequently, in two other cases of *petit mal* that came under my notice, the same similarity in the action of the bromide and electricity was noted. Recovery followed in one of these cases. The patient, a girl aged eleven years, first observed the attacks in the early part of 1884, and came under my observation in March, 1885. At first the paroxysms occurred but once or twice a week, but in about six months they began to increase in frequency, and for several months before I saw her she was having them as often as once, and sometimes three times, a day. The attacks were of short duration, lasting not more than half a minute to a minute and a half, and although for the time there was perfect unconsciousness, yet the patient, if standing, as was usually the case, never fell, but if engaged in any occupation immediately resumed it after the attack had passed away. I used at first the bromide of potassium alone, and pushed it until the face was covered with acne. As in other similar cases, she improved very decidedly through several

weeks, and then rather quickly relapsed. It is proper, however, to state that this relapse may have been due to a neglect, to which she confessed, of regularity in taking the medicine. I then subjected her to central galvanization and general faradization, alternating the methods and allowing a day to intervene between each application. She improved much less rapidly than under the bromide, but the improvement that followed was retained. At the end of three months she was having but one attack in a period varying from ten days to two weeks, and in just eighteen weeks from the beginning of treatment she had her last attack.

Another satisfactory case was in the person of a peddler, aged thirty-two, who entered my office for the purpose of disposing of his wares, March 14, 1877. The man was of respectable appearance and average intelligence, and while conversing with him he had a slight epileptic seizure, and would have fallen from his chair if I had not supported him. When consciousness returned, after what seemed to be a very short period—perhaps not longer than one or two minutes—he seemed to recognize the fact that the attack had been of short duration, and on inquiry gave the following history: He was a native of England, had been in this country two years, and had had his first epileptic attack eighteen months previously. As near as he could remember, the second attack occurred after an interval of six weeks—the third in four weeks; thereafter they gradually increased in frequency, and during the last six months had occurred as often as twice a week. Most of the attacks were light and soon over, as the one that I witnessed, but at least once a month, as he informed me, they were much more severe—the aura being recognizable—with slight lacerations of the tongue. He had been under no professional care, but had taken a good deal of "salty-tasting medicine," administered to him by some druggists. He recognized the name of bromide of potassium, and said he thought that it was the medicine.

Upon proposing that he submit himself to my treatment (gratuitously of course), he readily consented, and, thinking it to be a good and fair opportunity, I placed him under central galvanization, with occasional séances of general faradization. I treated him every day excepting Sundays (when I was out of town) for six weeks. On March 16th he had one of his severe attacks; March 22d, one of the slighter seizures; March 31st, another slight attack; April 14th, a third attack of a mild character. On April 20th a paroxysm of the more severe type took place, but evidently considerably modified in intensity and duration.

This was the last severe attack that he had. On May 4th he said that during the morning he thought that he had experienced a very slight paroxysm, but it was so transient that he was hardly aware of it. I

saw no more of him until the following September, when I accidentally met him on the street. He looked well, said that he had had no more attacks, expressed gratitude for the services rendered, and promised to call at my office, but failed to do so.

Dr. Meredith Clymer, in some excellent remarks on the treatment of epilepsy, states that he has never heard of a permanent cure of the disease under the use of the bromides, either alone or in combination. While we may regard this as an extreme statement, the suggestion that the best results will follow only when we call to our aid every measure that will tend to increase and develop vital power generally commends itself to all. It is not alone, therefore, on the theory of a special influence on the nerve-centres or over the cerebral circulation that we employ electricity as an adjuvant to the bromides, but also because of its undoubted and powerful constitutional tonic effects. In this, therefore, as in various other forms of central disease, I invariably associate and alternate general faradization with central galvanization.

Exophthalmic Goitre.—The opportunities for post-mortem examination in cases of Basedow's disease have been so few that its pathology is far from being satisfactorily ascertained, although it is true that very positive results have rewarded certain researches into the condition of the sympathetic. In eight cases structural change was discernible, although in a number the change was so slight as to be hardly recognizable, while in four cases not the slightest lesion could be detected. It seems fair to conclude, therefore (accepting the neurotic theory of the disease, rather than Basedow's hypothesis of a primary chlorotic affection, or the cardiac theory of Stokes), that the symptoms of exophthalmic goitre may proceed from purely functional as well as from organic disease of the sympathetic or any part of the central nervous system. In those cases that resist every form of treatment it seems quite probable that examination of the nerve would reveal greater or less diminution of the nerve-elements, together with gray infiltration and increase of the connective tissue, since these were the most important changes observed in the eight cases alluded to above; while curative results, such as have occurred through electrical and other methods of treatment, could have been obtained only when the conditions belonged to the class of so-called functional neuroses.

The benefit to be derived in cases of Basedow's disease from persistent and well-conducted treatment by electricity is far from being sufficiently appreciated. In the treatment of over thirty cases the method has in my hands been so successful in many of them that I urge its persistent use in every case. I may be allowed to detail a case, not only as an excellent example of the benefit that may follow this method of treatment, but as an illustration of the technique of the electrical application: The patient was a man aged thirty years, and had

been subjected to much mental disturbance and anxiety, which may have been important factors in the etiology of his disease. He was nervous and excitable, and when he first came to my clinic his pulse beat uniformly at the rate of 120 to the minute; there was, however, no enlargement of the thyroid, and only slight though perceptible protrusion of the eyeballs. While, therefore, the case is undoubtedly to be classed under the head of the disease under consideration, it was yet an incomplete type of Basedow's disease. The complete form of the disease is where the three cardinal symptoms—viz. accelerated heart-action, protrusion of the eyes, and enlargement of the thyroid—coexist. In such cases there can be no question as to the diagnosis, but where there are neither eye-symptoms nor thyroid enlargement, and even in such cases as this, where there is no goitre and only a very slight exophthalmus, we cannot always be so sure as to its correctness.

The essential feature of the disease, however, is the rapid pulse, due to some interference with the inhibitory power of the vagus, and true Basedow's disease may exist, represented by the single symptom of rapid heart. The diminished electrical resistance which Vigouroux claimed to be uniformly present in these cases does not seem to me to be of special importance as a diagnostic sign. In the case just referred to the resistance was 1500 ohms, somewhat less than when the test was applied to myself, but this difference was readily accounted for by the better conductibility of the skin of the patient, which at the time was quite moist with perspiration. In regard to these observations of Vigouroux and others concerning the diminished electrical resistance that has been noted in Basedow's disease, it does not seem to me that they can be of any special practical importance, diagnostic or otherwise. Every physiological consideration and all experience point to the galvanic current as pre-eminently indicated.

The faradic current is, however, not altogether useless, but its application must not be local, but general, after the method of general faradization, and in a certain proportion of cases in which there is anæmia, with marked nervous irritability, more or less benefit may be confidently expected. In the treatment of this case by the galvanic current the cathode was placed over the cilio-spinal centre, just above the seventh cervical vertebra, and the anode in the auriculo-maxillary fossa. After a few moments of stabile treatment the anode is gradually moved along the inner border of the sterno-cleido-mastoid muscle to its junction with the clavicle. The operation is then repeated with the anode upon the opposite side, and finally, changing both electrodes for those of much larger size, the anode is placed in the position first occupied by the cathode, and the cathode transferred to the solar plexus. With the small electrodes in the first position the milliampèremeter indicated a current strength of only ten milliampères, while

with the large electrodes in the second position (the same number of cells remaining in the circuit) the strength of the current was increased to fifty milliampères without special discomfort to the patient. Under this method of treatment, alternated with general faradization, the pulse of the patient was gradually reduced to 85; he became far less nervous and excitable and was discharged as approximately if not completely cured.

While I consider electricity the main reliance in the treatment of this disease, yet the most rigid and conscientious observance of certain fixed rules in regard to eating and drinking, and the avoidance not only of excess in every department of mental and physical hygiene, but the repression of ordinary and legitimate emotions and passions, becomes absolutely essential.

Paralysis.—Instead of attempting to discuss electricity as it relates to the multifarious manifestations that come under the head of the generic term "paralysis," I propose to give some observations of a general character, but which are yet applicable to almost every individual form of paralysis. If the galvanic current is passed continuously for a time along the course of a nerve its strength increases in a marked degree. One factor that goes to make up this increase, as is well known, is the better conductibility of the tissues gradually taking place at the seat of the recomposition of the current—a result due to congestion of the skin and adjacent parts under the electrodes.

That this explanation, however, of the increasing strength of the current where continuously passed through living tissues is but partial can be readily demonstrated. I apply the current from a given number of elements to the arm and forearm, and seven milliampères are immediately registered. In one minute there is an increase of one degree; in two minutes, an additional degree; and in eight minutes twelve milliampères are registered. That this extraordinary increase of strength is not caused by improved conduction alone I soon satisfy myself by applying vigorous friction to the other arm, and when the congestion is as intense as that produced by the electricity the electrodes are applied. Instead of seven, the instrument does indeed immediately register ten milliampères, but it is not until four more have elapsed that the additional two degrees are registered.

Another phenomenon, even more interesting than this, is the increased strength observed upon a reversal of the direction of the current. A current of fifteen cells was applied to the thigh of a patient (small electrodes being used), and the poles kept in position until twelve milliampères were registered. The current was then suddenly reversed, when the milliampèremeter immediately registered fourteen. To analyze the molecular disturbances that evidently take place during the passage of the galvanic current is a labor of the

greatest difficulty, and the phenomenon is one not yet thoroughly understood. Evidences, however, of the chemical action of electricity as it passes through the tissues are not wanting, and the sudden increase of strength is undoubtedly due to the electrolytic or polarizing action of the current exciting a secondary current in the living body similar to what is observed in a reservoir or secondary pile.

In contrast to this thoroughly scientific and demonstrable doctrine of Matteuci, we have the more vague and confused teachings based on the theory of electrotonos, the laws of which, while of great value, do not by any means account for all the phenomena and therapeutical activities of the galvanic current. On the other hand, the statement "that a therapeutical system, built on the opposite anelectrotonic and catelectrotonic effects rests upon an imaginary basis,"[1] seems to me altogether too sweeping.

To appreciate intelligently the force of those barbarous terms anelectrotonos and catelectrotonos, we must keep in mind the purely physical effects of the current in the tissues. These effects are exceedingly complex, for the composition of all organic tissues is complexity itself. Combinations and decompositions take place which are yet of an entirely unknown character.

The analogue of the electrolysis of organized tissue—animal or vegetable—although less complex in its nature, is seen in the electrolysis of acidulated water.

Acids go to the positive and alkalies to the negative pole: now it is a fact of physiology that acids diminish the irritability of nerves, while alkalies increase it. Anelectrotonos and catelectrotonos may therefore be caused by acids at the positive and alkalies at the negative pole. However this may be, it is as true now as when first demonstrated by Pflüger, that a nerve is *excited* by the appearance of catelectrotonos and the disappearance of anelectrotonos, but not by the appearance of anelectrotonos and the disappearance of catelectrotonos. In other words, irritability is increased near the negative pole, this condition of catelectrotonos increasing as the current runs up to a certain point. On breaking the current the negative modification, or condition of diminished irritability, appears for a moment and then disappears. Near the positive pole, on the other hand, the irritability is diminished after closing the current. On breaking the current there is an increase of irritability or positive modification, which appears to be greater when the current has been allowed to run a long time. But, whatever theory we accept, the fact remains that it is not alone the increased conductibility of the tissues that enables the current to act with such increased vigor, but phenomena of a purely physiological or physico-chemical order. It is in the consideration of paralysis in its various

[1] "Conditions of the Unipolar Stimulation," etc., *Brain*, Part ix.

forms, more especially, that these cumulative effects of electricity would seem to be of value, but experience points to other conditions in which it is applicable. In paralysis of central origin, when there is increased irritability of the paralyzed nerve, any attempt to produce muscular contractions is uncalled for and may do harm. The continuous passage of a galvanic current, however, is useful, and, provided no interruptions are allowed and the current is not reversed, a moderate modification of the excessive irritability may be quite confidently expected.

In cases of hemiplegia, when the irritability of the nerve is more or less impaired, the continuous passage of the current accomplishes more for the patient than the attempts at frequent muscular contractions that are so popular. The difference in the treatment of hemiplegia with increased nerve-irritability and hemiplegia with decreased nerve-irritability is simply this: In the former it would be as inadmissible to allow interruptions of the current or a change in its direction as it would be in a case of neuralgia. In the latter, on the contrary, a few interruptions can with good effect be given at the close of an uninterrupted séance, and a reversal of the current adds to the efficacy of the treatment. My attention was called to the practical value of what I term the cumulative effects of electricity by observations more particularly in various forms of peripheral paralysis and in the essential paralysis of childhood. I have, of course, treated many cases of infantile paralysis, and, in common with others, have had both successes and failures; and up to within a few years all of these results, both good and indifferent, followed the rough and excessively stimulating method of current-interruptions. Before electricity had the slightest recognition as a constitutional tonic and sedative, and as such was indicated in a great variety of disorders, it was rather contemptuously assigned the position of a harsh stimulus and of some value in "pricking up paralyzed muscles."

No statement of the damage inflicted by the practical application of this crude and primitive enunciation has ever been made, but I am confident that great and fatal mistakes have arisen therefrom.

Two cases of infantile paralysis have come under my observation in which but the slightest suggestion of nerve-irritability existed, and when, after rough usage—in one instance by the faradic and in the other by the galvanic current—the slight vestige of vitality in the paralyzed members became extinguished and the cases hopeless. On the other hand, I have seen cases in which the nerve-irritability was equally impaired pursue an entirely different course under an entirely different method of treatment. Sudden galvanic shocks, whatever useful purpose they may occasionally serve, are often extremely dangerous. Their effects are, in the main, undue stimulation, and, in their relation to nutrition, destructive rather than reconstructive.

The continuous passage of the current, however, while in a certain sense stimulating in its effects, combines influences that are sedative and tonic, and pre-eminently reconstructive, and is alone equal to the task of resisting progressive degenerative changes in nerve and muscle. I could easily cite a number of cases of infantile paralysis as illustrative of the principles here enunciated, but will only give, with some minuteness of detail, the history of a single case. It was in the observation of this case more especially that I became thoroughly alive, on the one hand, to the importance of the continuous action of the galvanic current, and, on the other, quite as positive as to irreparable damage to nutrition, in conditions both of increased and diminished nerve-irritability, by the injudicious use of the interrupted galvanic current.

In October, 1884, a boy, aged five, was brought to my office suffering from complete paralysis of the right leg, and, in a less degree, of the left also. The muscles of the right thigh and leg had atrophied to such an extent that the bones seemed to be covered with little more than skin, and it is hardly necessary to say that to the faradic current there was not the slightest reaction. The galvanic current also seemed at first unable to elicit any evidence of nerve-irritability, but upon more careful electrical interrogation exceedingly slight contractions of some of the extensors of the foot were observed, but associated with decided qualitative changes.

In the left leg, which had atrophied to a considerable extent, I found quantitative changes, but no reaction indicating tissue-degeneration. About a year previously the child had been seriously reduced in flesh and strength by a prolonged diarrhœal attack, culminating in a series of severe convulsions, followed by fever, and associated, probably, with acute polio-myelitis anterior. Paralysis of the legs followed, and for a few days the loss of voluntary motion was complete. Within a week, however, without special treatment the limbs gradually began to resume their function, until the patient could freely move them, the left one becoming sufficiently strong for him to bear his weight upon it.

Improvement seemed to stop at this point, and some time subsequently the mother, although not a poor woman, sought advice at one of our college clinics. Here electricity was used, and, according to the statement of the mother, the foot became rapidly extended many times in rapid succession during the application. This process, evidently a strong interrupted galvanic current, was repeated quite a number of times at varying intervals, until finally the observant mother noticed that not only were the contractions less marked, but the power of voluntary movement in both limbs was decreasing in a decided degree. She ceased her visits, abandoning all treatment, but the limbs steadily continued to decrease in strength and size, until, when I saw the child, the left leg had reached, as already stated, an extreme condition of atrophy, with

marked reaction of degeneration in the few muscles that still retained some slight evidences of electro-muscular contractility. The case seemed sufficiently hopeless, but, explaining to the mother, who dreaded any further trial of electricity, the entirely different method that would be adopted, and impressing on her mind the necessity of patience, I began the application of the uninterrupted galvanic current with a strength of only five milliampères and a séance of five minutes in duration. The applications were for a time made daily, and at each sitting the duration was increased by one minute and the strength of the current by one milliampère, until at the end of two weeks the patient was receiving applications of fifteen minutes and a current-strength of fifteen milliampères.

During this time, although reversed currents were used every day, not a single galvanic interruption had occurred. Examining now the condition of electrical excitability, I was gratified to find not only increased vigor in the contractions of the extensor muscles, but slight yet appreciable contractions in muscles which had before failed to respond to the most searching electrical interrogation. The reactions were yet, however, those of degeneration. This patient continued under observation and treatment a long time, the limbs improving from month to month in nutrition, and necessarily in electrical reaction. At the end of eight months the patient could walk aided by a cane, although with considerable awkwardness, and the electrical reactions were normal, with the exception of a slight quantitative defect in the left leg, which continued also quite deficient in size. The lessons to be learned from this case are undeniably important.

If the mother could be trusted in her statements—and she was an unusually intelligent and observant woman—the main points were these:

Following an attack of acute polio-myelitis anterior we have the characteristic paralysis of the lower limbs. Spontaneous improvement, but only up to a certain point, soon appears. Shortly after, strong interrupted galvanic currents are most imprudently administered, resulting finally in almost entirely obliterating a condition of nerve-irritability that was already greatly impaired. The damage inflicted was almost irreparable. The muscles waste and the reaction of degeneration appears.

Finally, when the paralysis was practically complete, the aid of a mild continuous galvanic current was evoked, and increased from time to time as prudence dictated. Nutrition is immediately and favorably influenced—the muscles increasing in size and strength, the electrical reactions becoming normal, and, in the end, the disabled members are sufficiently restored to be of decided service. In various other forms of disease these principles are no less applicable than in paralysis, the

difference being that, while in neuralgias and most nervous symptoms it is more universally understood that continuous currents are indicated, in paralysis it is too often taken for granted that the more prompt and vigorous the stimulation the greater the benefit.

The injury that may be inflicted upon paralyzed members by this method has already been emphasized, but it is to be observed that such injury does not as a rule follow occasional or accidental shocks, but only when administered with a good degree of vigor and as a supposed necessity of treatment.

It has been denied that electricity exerts any favorable influence over the process of peripheral-nerve degeneration, and, as facial paralysis is among the more important peripheral nervous diseases, it will be interesting to consider the questions: 1st. Does electricity sensibly hasten recovery in cases of peripheral facial paralysis? 2d. In what class of cases is it especially serviceable?

A case, briefly stated, will aid in answering these questions:

The patient was a woman who came to me a short time since suffering from typical facial paralysis of the right side. Seven weeks before she awoke in the morning only to find her face paralyzed. She immediately went to her physician, who applied the faradic current and repeated the application daily, Sundays included, for seven weeks. At the end of that time there was no improvement. He then came with her to my office, when I found no reaction to faradism, but, on the contrary, a greatly *increased* reaction to galvanism. The uninterrupted galvanic current was substituted for the faradic, and in a few days a decided improvement was manifest. It required a decreasing strength of galvanism to produce contractions of the facial muscles, and on the sixth day farado-muscular contractility appeared, and within a month the muscles contracted normally to both currents, and the paralysis had approximately disappeared.

Such a case as this not only helps to answer in the affirmative the first question, Does electricity sensibly hasten recovery in peripheral paralysis? but also gives a clew as to the class of cases that are most benefited by the current. The faradic current causes contractions through its action on the intramuscular nerves, and not on the muscular fibre, while the galvanic acts powerfully on muscular fibre and less vigorously on intramuscular nerves. When, therefore, a muscle is deprived of its nerve-influence in any way, the faradic current is powerless to contract it, while galvanism not only causes contractions, but calls them forth even more vigorously than in health; and this in proportion to the strength of the current and the slowness of the interruptions. In cases similar to the one to which allusion has been made the intramuscular nerves are undoubtedly paralyzed from the beginning, but the muscular fibre is intact, and, through checks to

inhibition or faulty nutrition, we see a remarkable increase of galvano-muscular contractility. While the cases, according to my observation, that respond most promptly to electrical treatment are those that present this anomalous reversal of muscular contractility to galvanic interrogation, rather than those in which there exists an impaired reaction to both currents, we yet find many cases of lost farado-muscular contractility associated with increased galvano-muscular contractility that show little tendency to progress rapidly under electrical treatment. Such are the cases that we might naturally suppose to be dependent upon a neuritis within the Fallopian canal.

I cannot indeed see how electricity can be of much use in cases of facial paralysis caused by a neuritis within the bony canal and the consequent swelling and compression of the nerve-fibres; but it is not difficult to understand how it can be of service if the nerve-terminals alone, or that portion of the nerve external to the Fallopian canal, are mainly affected. Gowers, in his great and conservative work on nervous diseases, insists that there is no evidence that cold ever paralyzes the intramuscular nerves, and doubts whether inflammation ever affects the nerve after its emergence from the canal. If this is true, then it is difficult to account for some of the rapid recoveries that have taken place in cases that were apparently stationary, when subjected to the proper current.

While admitting that electricity possesses only a limited range of usefulness in severe lesions of either the central or peripheral nervous system, I think it is one of the most efficient remedies we possess for the relief of the various symptoms associated with these lesions, while for the removal of the finer nutritive disturbances that underlie many persistent neuralgias the galvanic current is certainly a remedy of the greatest value.

But whatever good is accomplished by the current in arresting degenerative processes in nerve and muscle, it must be through attention to the details of methods of application.

Years ago my attention was called to the irreparable injury that may accrue from sudden galvanic shocks in certain cases of paralysis. These observations were made more especially in the essential paralysis of childhood, but are equally applicable to cases of peripheral paralysis; and therefore in any case of this type in which there exists either marked decrease or increase of electro-muscular contractility or irritability, and especially when we have associated the characteristic "reactions of degeneration," it is far better treatment to avoid frequent interruptions of the current, the effects of which, as before remarked, are undue stimulation, and in their relation to nutrition destructive rather than reconstructive.

Whatever power this agent possesses to resist progressive degene-

rative changes in nerve and muscle, it is more by its continuous passage and the induction of those cumulative effects that come from current reversal without shock than the ordinary method of slow or rapid interruption.

As in facial paralysis, the ultimate tendency to recovery in diphtheritic paralysis renders it a matter of no little difficulty to ascertain the influence of methods of treatment; but if electricity is powerless to neutralize the early stages of the morbid process or prevent the spread of the paralysis, the records of experience have unmistakably demonstrated its beneficial influence in many old cases of altered nutrition of nerve and muscle.

Paraplegia, when dependent upon chronic structural disease of the cord, offers an unfavorable prognosis under any method of treatment, but both in subacute and chronic anterior polio-myelitis and ordinary myelitis the results of electrical treatment are often of the most gratifying character. Subacute and chronic polio-myelitis anterior are characterized, as a rule, by a rapid and progressive atrophic paralysis of the lower limbs, with frequent involvement of the arms. Like the acute form, the symptoms are probably due to nutritive changes of the anterior gray columns without the destructive character of the former. The degenerative reaction in the muscles soon becomes distinctly marked, associated with weakness and atrophy. The muscular atrophy occurs irregularly, but is generally widespread, certain groups of muscles being far more affected than others. In most of the subacute cases the reactions of degeneration that are observed are of the common form—*i. e.* loss of or decrease of faradic irritability, and for a considerable time increased galvanic irritability.

Erb has described a "middle" or mixed form of degenerative reaction occasionally met with, where the nerve presents normal and the muscle increased irritability. In these cases the faradic current applied to the nerve calls forth normal contractions, while the galvanic applied to the muscle indicates that the irritability of the muscular fibre is increased. When the reactions of degeneration are but partly developed, the faradic current often proves useful as a peripheral irritant, but in the most severe cases the galvanic current alone should be used, even for peripheral applications. For the most part, the current should be continuous, as in the treatment of infantile paralysis, interruptions being used only at the beginning and closing of each séance, and occasionally for prognostic data.

The spine should not be neglected in these cases, the treatment consisting of applications of the galvanic current of a strength no greater than can be readily borne by the patient. Ten or fifteen milliampères are usually sufficient, and applied through electrodes that are slowly but constantly kept in motion.

From the fact that there is an undoubted tendency in many cases of this disease toward spontaneous recovery more or less complete, it is no easy matter to determine the relative efficiency of different methods of treatment. Observations in the treatment of quite a number of cases of this character convince me that electricity not only markedly accelerates the progress toward recovery in those cases in which the tendency is in that direction, but may even turn the tide when the patient is steadily advancing toward complete helplessness. I saw in March, 1890, a male patient who verified this opinion in a most unmistakable manner. In the latter part of December, 1889, after prolonged exposure to cold and wind, the patient was confined to his bed by an attack of fever of considerable severity that lasted several days. When it subsided he experienced a feeling of heaviness in the lower limbs, although he could yet walk without great difficulty. He progressively lost power over the legs, and to a considerable extent over the arms also, without any disturbance of the sensory nerves. Muscular wasting began early in the course of the disease, and when I saw the case, three months later, the atrophy was extreme and the patient could with difficulty make his way from his chair to his bed. In testing by the faradic current, it was found that the different groups of muscles varied in the readiness of their reactions. The toes could be slightly flexed by the application of a strong current to the flexors of the legs, but application to the extensors failed to move the toes in the slightest degree. Circumstances prevented my seeing the patient again for nearly two weeks, when a second test with the same current elicited the fact that the flexors had now lost the slight irritability that was present two weeks before. Interrogation with the galvanic current showed marked changes, both quantitative and qualitative. (See *Electro-diagnosis.*) Applications of the galvanic current to both spine and the extremities were repeated nearly every day for some three months, and resulted in an approximate cure. To the spine the applications were by the labile method, and to the limbs by the stabile. Continuous currents were used, excepting when applied to the limbs, when at the end of each séance a few interruptions with reversal of the current were given.

The interesting point to be observed is that, whereas up to the date when electrical treatment was begun the symptoms were increasing in severity with steady progression, improvement was observed, if not from the first day, at least from the first week of the introduction of the galvanic treatment.

In acute myelitis electricity is contraindicated. In the subacute and chronic forms there is every probability of its aiding in recovery when there is a tendency in that direction. Erb says that there is little chance of good effect from electrical treatment apart from those forms which are restricted to the anterior gray columns and the funicu-

lar degenerations. This has not been my experience. The case which I here give is one of a number equally positive in the results of treatment that I might relate. This case was shown before the American Neurological Association, and examined by a large number of prominent neurologists, some of whom doubted the correctness of diagnosis on the ground that it was impossible, in their judgment, to obtain such results in a true case of transverse myelitis. The patient, a young girl of sixteen, was referred to me by her family physician, Dr. J. D. Farrington of New York City. Three months previously she went on a Sunday-school excursion to the seashore, and all through the day experienced more or less physical depression, and, instead of actively engaging in exercise, she sat much of the time on rocks near the water which may have been damp from the tide. Upon returning from the picnic she felt cold, and was so bent over that she could walk only with difficulty. During the night and for several days she suffered acutely, and within a week the lower limbs became completely paralyzed, as well as the sphincters of both rectum and bladder. There existed not only inability to prevent evacuation of either the bladder or rectum, but there was an absolute unconsciousness of need in that direction. She suffered, consequently, from an aggravated form of constipation and from incontinence of fæces after the aperient that was regularly required. Incontinence of urine was a constant symptom, supplemented by a severe attack of cystitis and accompanied by acute pain.

After six weeks of suffering a bed-sore made its appearance in the region of the last lumbar vertebra. It resisted all treatment, and rapidly enlarged until it was about two inches in diameter. In the early days of her illness the patient was extremely nervous and sleepless. A subcutaneous injection of morphine induced but two hours' sleep. On the second night its administration was followed by but a single hour's repose, and finally it was discontinued altogether, as it failed to induce sleep and greatly aggravated the nervousness. After two weeks of this persistent insomnia she began once more to sleep naturally. For two months she lived almost entirely on milk and champagne. When I saw the patient she was emaciated to the last degree.

Electro-muscular irritability to both currents was entirely abolished, the sphincters were paralyzed, the legs were contracted beyond the power of forcible extension, and the bed-sore was large, with a tendency to increase. The limbs were sensitive to the touch, with the paradoxical symptom of diminished sensibility when tested with the æsthesiometer. A marked perversion of sensibility was evidenced by the exceedingly disagreeable numb feeling excited by the induced current.

After seeing the case with Dr. Farrington, I agreed with him that the prognosis was most unpromising, and it was only at the urgent

solicitation of the patient's father that any further active treatment was attempted.

The faradic current had been used for several weeks previously, but, as was to be expected, without any effect whatever.

I immediately began galvanizing the legs and the lower portion of the spine, using a current strength varying from ten to twenty milliampères, and repeating the applications every other day. Three weeks of persistent effort failed to elicit any response in the way of muscular contractions, and the only evidence that the treatment might possibly be doing good service was the condition of the bed-sore. It began to assume a less dull and sluggish character and its periphery seemed to be contracting. At the end of the fourth week very faint muscular contractions were observed, and within another week they had so increased in vigor as to render it possible to interpret their character. They were markedly the reactions of degeneration. Those who have given much attention to these phenomena know how difficult it sometimes is to eliminate all sources of errors and to determine the exact order in which these irregular contractions occur. In this case, however, it was not so difficult as I have sometimes found it to satisfy myself on this point. The A. C. C. (anodal closure contraction) was decidedly more vigorous than the C. C. C. (cathodal closure contraction). From this time onward the patient steadily improved. The electrical reactions became quite normal, and within a month the bed-sore had entirely healed. The patient regained power over the bladder more rapidly than over the bowels, but within two months she had complete control over both fæces and urine. She was treated about four months, and at the end of that time was discharged as cured, with the exception of slight weakness in the flexor muscles of the right leg. This weakness still remains, indicating a possible irreparable damage to certain nerve-cells.

There can be little doubt that this case was in the beginning one of acute inflammation of the cord. What the exact pathological condition was in its secondary and chronic stage may be a question involving a greater difference of opinion. The tendency probably was either to degenerative softening or to atrophy of the ganglion-cells, and, to my mind, it was the second rather than the first pathological change that prevailed in this case; and that the whole transverse area of the cord was involved was evidenced by the complete abolition of both afferent and efferent nerve-function.

The practical value of this case, so far as relates to the pathological side, is in its distinct negation rather than in any affirmation. It is self-evident that, however much structural change had taken place in the way of atrophy of nerve-cells or induration or overgrowth of connective tissue, the nutrition of these nerve-cells had not

been sufficiently impaired to be beyond the influence of the reparative process.

In its therapeutic aspect the lesson taught can not be too strongly emphasized. Four physicians, including myself, who had become interested in the case, regarded the condition as entirely hopeless. The father, in the face of a completely discouraging prognosis, insisted that unceasing effort should be made, and subsequently his triumphant but somewhat reproachful thought was, "What would have become of my child if I had been guided by the professional opinion so confidently expressed?"

Posterior Spinal Sclerosis (Locomotor ataxia).—This disease is frequently relieved, but never cured, by electrical treatment. Many cases of ataxia have indeed recovered, not only under electrical, but under other methods of treatment, and I myself have observed recoveries more or less complete in cases in which the symptoms, both objective and subjective, simulated the most severe forms of locomotor ataxia. In one case the symptoms were undoubtedly dependent upon a syphilitic cause. Anæsthesia was present, together with the most marked inco-ordination of movement, but under persistent antisyphilitic treatment recovery was finally complete. Profound inco-ordination of movement, with neuralgic pains and anæsthesia, may follow severe concussion of the cord, and in these cases recovery is likely to occur, and with far greater rapidity, either under general applications of the faradic current or galvanization of the spine, than if these methods are dispensed with. The discrepancies in the statements of the effect of electricity in true locomotor ataxia is due, therefore, to the fact that symptoms which are more or less transient in their nature are mistaken for symptoms which follow lesions that come on slowly after long years of incubation.

The electro-muscular contractility of ataxia is generally normal, seldom increased, and never decreased excepting when complicated with pathological changes in other parts of the cord. In regard to electrical applications, the direct treatment of the spine is perhaps the most important, and for the possible relief of any symptoms in old cases of spinal sclerosis I prefer strong ascending currents. In cases dependent on concussion, or those in which an irritative condition is believed to be present, the descending current is to be preferred. What is needed is that as strong a current as possible be passed through the cord, and so rapidly do the threads of current diverge from the seats of their recomposition that, at the best, only a slight influence can be exerted upon the substance of the cord itself. Long before the current becomes strong enough to cause any possible ill-effect on the spinal cord it causes unbearable pain in the skin under the electrodes. To get the best effects, therefore, the electrodes should be rather large and some distance apart. A stabile treatment is to be preferred, but the points

of application should be successively changed, so as to bring all the diseased part under the influence of as dense a current as possible.

General faradization is a most useful procedure for the relief of symptoms in not a few cases of locomotor ataxia. This it does by its general effects upon the periphery; and by making the applications thorough—from the head to the feet—the lightning-like pains that are so distressing are often most markedly relieved. By the use of the wire brush to the integument the sensory nerves are subjected to severe stimulation, which exerts on the cord an indirect effect of a beneficial nature.

Progressive Muscular Atrophy.—Electricity is of some value in this disease. That it sometimes arrests its progress is undoubtedly true, but it is doubtful whether it ever radically cures or *permanently* arrests it. As the nerves are unaffected, both galvanism and faradism to nerve will generally call forth reactions throughout the disease, but electrization directly to muscle shows diminished, and finally lost, contractility. The methods to be pursued in these cases are—first, the direct treatment by the galvanic current, either central galvanization or transverse conduction of the cord through the mastoid processes, supplemented by galvanization of the sympathetic and the cervical spinal cord; and, second, persistent faradization of individual muscles, by which simple and single method alone good results may follow.

Paralysis Agitans.—The treatment of many cases of this disease only confirms the statement of Erb and others of its generally incurable character. In the majority of cases, indeed, which fall under one's observation the palliation of symptoms amounts to little or nothing. When occurring in persons over fifty years of age there seems to be absolutely no hope of recovery, but in the decade between forty and fifty the results of electrical treatment are not altogether barren. In one case of exceedingly violent palsy agitans occurring in a robust man of forty-two, treatment by central galvanization and faradization of the periphery resulted in an absolute cure; and in another case, in the person of a woman of about the same age, the symptoms became through the same methods of treatment very much subdued, although recovery was never complete.

Occupation Neuroses.—Those forms of functional neuroses which have been sometimes termed professional hyperkineses have always presented on their therapeutical side a difficult problem. Writer's cramp is perhaps the most common of these neuroses, although analogous conditions relating to other occupations—telegraphy, piano-playing, typewriting, sewing, cigar-making, etc.—are frequently met with. They all "present the common feature that in certain complicated and delicate manipulations disturbances of movement occur which interfere with

the manipulation in question or render it entirely impossible." Electrical treatment in these cases, while yielding results by no means entirely satisfactory, is far from being useless.

Electrical examination indicates no special changes in the muscular reactions. Nerve-exhaustion is manifestly present, though whether mainly located in the peripheral parts or in the spinal cord, basal ganglia, or cortex of the brain, it is impossible to determine. In these cases are sometimes observed localized atrophy, neuritis, or anæsthesia, and these symptoms should receive local treatment, the faradic current being used for the first and last symptom, and the galvanic for the neuritis.

To obtain, however, the best results that electricity is capable of giving in these cases the galvanic current must be applied to the brain, the spinal cord, and the sympathetic.

The method of central galvanization, if carried out in all its fulness of detail, will answer all practical purposes. Not only writer's spasm, but the other forms of functional neuroses characterized by disturbances of movement which interfere with complicated and delicate manipulations, are treated with some success by electricity. This much, however, must be said of all spasmodic diseases: When of long standing it is difficult to do much for them, and even when relieved the symptoms are liable to recur. If recent, the symptoms, although severe, are not infrequently palliated at once by electrical treatment, and in many cases perfect recovery takes place. In all these cases rest from the occupation is imperative, for it is almost useless to attempt treatment if the patient is permitted to continue the manipulations that have caused the disease. The galvanic current is to be relied upon for the most part, and the treatment should be both central and peripheral. The faradic current, however, is by no means useless, and as a rule better results are obtained when these currents are used in alternation than by the exclusive use of galvanism. I have many times observed at least temporary alleviation of the symptoms of writer's cramp follow mild applications of a descending faradic current of tension, and in some of the fortunate cases of complete recovery the results could not, I am assured, have been so readily obtained without its aid.

Torticollis.—Torticollis, when chronic, offers a very unpromising prognosis, but in its early stages it is often cured by electrical treatment alone, and with a rapidity that leaves no doubt as to the efficacy of the remedy. I believe that no case should be abandoned until after the most thorough treatment by both the galvanic and faradic currents. Many years ago I reported a severe case of wry neck that promptly recovered under the following treatment:[1] At each sitting the muscles

[1] *A Practical Treatise on Medical and Surgical Electricity.* 6th ed. p. 494. Beard and Rockwell.

of the left side (those that were large and prominent) were submitted to mild galvanization, while the contracted sterno-cleido-mastoid muscle of the right side, toward which the head was inclined, was faradized with sufficient force to cause a relaxation of muscular fibre, allowing the head to turn gradually to its normal position. After recovery the patient had no return of the symptoms for more than ten years, but some weeks previously to the preparation of this article she, for the first time, presented herself in as bad a condition as before. The same method of treatment was adopted, and she has again recovered.

The case was undoubtedly one of true torticollis, and not simply an ordinary stiff neck, and is an important illustrative example of the value of electricity in this condition.

Angina Pectoris.—Neuralgia of the cardiac nerves yields but indifferently to any method of treatment, although both galvanization and faradization have occasionally brought about results of a palliative, and even curative, nature in cases that were thought to be incurable. The best results have followed without doubt when sensory rather than motor irritation predominated. Electricity certainly seems to exercise its best effects in those cases in which the pain is of a very positive neuralgic character, with no coexisting organic disease, although the presence of structural changes in the heart and blood-vessels does not contraindicate the judicious use of either form of current. Numerous experiments, on the contrary, go to prove that electrical applications strengthen a failing heart. Ziemssen's well-known experiments will be recalled. He found that the application of galvanic currents of considerable strength directly to the integument over the heart, the anterior wall of the thorax having been removed, influenced in a most positive manner the frequency and rhythm of the heart-beats. In the electrolytic treatment of scirrhous tumors of the breast I have had occasion many times to witness the powerful stimulating effects of the galvanic current on flagging heart-action. I was enabled on one occasion to submit these observations to a practical test in a long-standing case of angina pectoris of an incurable type. During the paroxysms of pain, which generally lasted from ten to fifteen minutes, the heart's action became exceedingly weak and the pulse barely perceptible, and on several occasions unconsciousness supervened. On the occasion of one of these attacks one electrode was applied to the cardiac region just below the left nipple, and the other over the upper dorsal vertebra. Under the influence of a continuous galvanic current thirty milliampères in strength there was an immediate change in the vigor and form of the contractions, indicating the very powerful effect exerted by the current over the motor ganglionic centres of the heart.

Among the numberless neurotic symptoms which accompany hysteria, vaso-motor disturbances are the most distressing. They seem

occasionally to take on the form of a severe attack of angina pectoris. There is cardiac pain, giddiness, pallor, faintness, and even syncope. In these cases I have often found electricity to exercise a most beneficial influence after the failure of persistent internal medication. No local treatment will serve our purpose, however, in these cases. The most thorough form of general faradization and central galvanization is called for, and meets the undoubted constitutional indications as few remedies can.

Insanity.—Every theoretical consideration, as well as the many practical illustrations of the therapeutic powers of electricity, in obscure forms of nervous diseases would suggest for it a place in the treatment of insanity. No one doubts its favorable influence over many forms of the psychoses, and yet as a remedy occupying any well-defined position in the treatment of mental disease it has not received special recognition, nor has it been subjected to any adequate test. And yet in diseases of the brain in which the mind is seriously affected there may be just as strong indications for the use of electricity as in diseases of the spinal cord that interfere with sensation and motion, or in diseases of other organs that interfere with their functional activity. In the incipient stages of mental derangement we may have to deal in many cases with simple functional disturbance, due to mild nutritive-molecular changes that elude discovery by our present methods of examination. Arndt, who has given much attention to the treatment of the psychoses by electricity, says: "Only such psychical disorders as depend upon so-called functional disturbances, or on temporary anomalous nutritive processes, or on circulatory derangements, can be cured by electrical currents; they may also be useful in deeper-seated organic changes if we seek amelioration merely. Electrical treatment is therefore specially adapted for fresh cases; rather for the milder, vague forms than for those which are characterized by violent symptoms. The faradic current simply acts as a stimulating measure; it acts successfully, especially in simple conditions of depression, whether they have developed primarily or as the result of previous violent processes. It is employed almost exclusively in cutaneous irritation of various portions of the skin; occasionally as faradization of the phrenic nerves, in order to stimulate the circulation and oxidation of the blood."

The galvanic current, however, far more frequently affords relief in cases of mental derangement than the faradic, and did space permit I could give many proofs of its efficiency. Not alone, however, should it be applied, as Arndt has suggested, to the spinal cord (and medulla oblongata), with its important vaso-motor, circulatory, and respiratory centres, but directly to the head itself. Vaso-motor disturbances are predominant in many cases of mental disease, and for their relief elec-

trical currents, so directed as to influence the upper portion of the cord and the sympathetic with its various ganglia, are strongly indicated. The most important therapeutic effects of electricity in the psychoses, however, are developed through its catalytic action on the brain itself; and to this end the galvanic current must be applied so as directly to affect the brain.

The insane suffer from nutritive changes of the nervous system almost if not quite imperceptible, as well as from the grosser anatomical lesions and degenerative processes. While electricity is quite useless in the latter condition, it ought, theoretically, to be not altogether without influence in the first, and practically it has in some cases been found to render excellent service. Just as it improves the nutrition of the muscular and peripheral nervous system, so does it favorably affect impaired nutritive conditions of the nerve-centres.

Central galvanization is undoubtedly the best method of bringing the central nervous system directly under the influence of the galvanic current. The method may be varied by galvanization of the brain, cervical sympathetic, and spine, but the method of central galvanization is easier, safer, and more effective. In cases associated with debility, and especially in those forms of insanity dependent on neurasthenia, general faradization answers a good purpose, and may with great advantage be alternated with central galvanization or localized galvanization of the nerve-centres.

More than usual care should be exercised over the dosage in the treatment of any form of mental derangement, for in these cases we meet with the extremes of tolerance and susceptibility. Some patients call for mild applications with long intervals between them, while others can bear with advantage strong and frequent applications. It is seldom necessary to apply a current strength of more than twenty milliampères, and in some cases that of five milliampères is all that will be required.

Exceptions, however, are always encountered, and I have met with cases of profound melancholia in which a current to the head of more than two or three milliampères was not only unpleasantly felt at the time, but left disagreeable sensations for some time subsequently. On the contrary, in one case of dementia with cataleptic symptoms that fell under my observation the unusual strength of thirty-five milliampères was applied to the head, not only without any present ill effects, but with undoubted good results. The interesting feature in this case, as in forms of cephalalgia to which allusion has been made, was the observation that as improvement in the mental symptoms progressed it became necessary to use a decreasing strength of current.

Nervous Dyspepsia.—I thoroughly believe in such a condition as nervous dyspepsia, and in the efficiency of electricity as a remedy for its relief. In some forms of nervous dyspepsia the food seems to be

digested in a reasonable period, but the process of digestion is always accompanied by symptoms either general or local, or both combined, that are not only disagreeable, but in some cases of a very distressing character. Whether these symptoms depend upon a simple local irritability or a disturbed condition of the entire nervous system cannot always be made out. In other forms, due perhaps to inactivity of the glands of the stomach or an impaired action of its muscular coats, the active process of digestion is seriously disturbed. For both these conditions electricity is a valuable remedy. In cases of the first type I have known central galvanization to modify very materially the symptoms. The cathode should be pressed firmly into the epigastrium, and after treating the head with the anode let it rest at the back of the neck (cilio-spinal centre), and pass a current ranging in strength from ten, and sometimes even to fifty, milliampères.

General neurasthenia is oftentimes associated in these dyspeptic cases, and therefore general faradization, while meeting the constitutional condition, often succeeds in dissipating the more local symptoms.

In cases of deficient innervation of the glands of the stomach or loss of tone of its muscular coats localized galvanization, and especially powerful applications of localized faradization, can be used with advantage.

In connection with nervous dyspepsia, and more frequently perhaps independently of it, we observe cases of atony of the stomach. Atony of the stomach cannot exist for a long time without developing into dilatation; and it is this condition of the two that we are most frequently called upon to treat. For the purpose of stimulating to contraction the muscular coats of the stomach electricity is manifestly the very best agent at our command. By stimulating contraction and relieving the dilatation we directly aid in overcoming the atony, the primary cause of all subsequent difficulty.

Although the galvanic current is recommended by some, and notably by Onimus, who gives very definite instructions as to the method to be employed, the faradic current is preferred by the majority of those who have any recorded experience. Simple external applications have proved effective in many cases. A good-sized electrode—say three inches in diameter—should be applied on the back as nearly as possible over the cardiac extremity of the stomach. The other electrode—preferably the anode—may be placed at the epigastrium, and then moved over the surface until all parts of the gastric region have been influenced. External applications are, however, frequently inefficient, and more active and direct treatment must be resorted to. Applications should be made directly to the interior of the stomach by means of olive-shaped metal electrodes. Some patients are so sensitive that it is almost impossible to pass the instrument, but when there is tolerance the treatment becomes a very simple matter.

Nervous Asthma.—Ordinarily, perhaps, asthma cannot be classed as a purely nervous affection, but there are, I am persuaded, many cases which are of neurotic origin, and which indicate this origin by the readiness with which the symptoms are allayed by electrical treatment. Taking the cases of asthma as they successively come under our observation, the majority undoubtedly fail to receive any marked benefit from either the galvanic or faradic treatment, and for this reason it has been asserted that no good ever comes from such methods. My experience has been far from sustaining this opinion, for in a certain proportion of any given number of cases I have always found more or less benefit to accrue, more especially from applications of the galvanic current. The difficulty in most cases is in the use of too weak currents.

It should always be remembered that the most efficient action of electricity is at the points of the recomposition of the current—*i. e.* immediately underneath the electrodes; that the threads of current diverge widely and abruptly, and in order to submit the deeper-seated tissues to catalytic influences of any force the external applications must be proportionately strong. Many who have used electricity for years are surprised when told that currents of forty milliampères have been sometimes used to the head, and even sixty and seventy milliampères in applications to the neck.

Everything depends upon the size and adaptation of the electrodes, and when these are properly adjusted, and the current increased gradually and without interruptions, the difficulty of applying currents of sufficient strength readily resolves itself. While my experience teaches me that strong currents are, as a rule, indicated in asthmatic cases, and that we shall fail generally to distinguish between the relievable and unrelievable forms if the treatment is not vigorously attempted, cases are occasionally met with which yield fair results under milder applications. In the case of a little boy aged thirteen lately under my care apparent recovery took place under the persistent use of a current-strength not exceeding ten milliampères. The usual position of the anode in this case was at the inner border of the lower portion of the sterno-cleido-mastoid muscle, and of the cathode on the extreme upper portion of the spine. Toward the close of each attack a copious expectoration of a substance much resembling boiled rice or starch took place, quickly followed by complete relief. The interesting observation in connection with the application of the electricity was, that the treatment, when attempted at the beginning of an attack, invariably cut it short and hastened the inevitable mucous discharge.

Even the faradic current affords relief at times. On the theory that asthma is associated with nerve-irritation in the upper part of the respiratory tract, both Schaeffer and Brisgen have applied the faradic

current vigorously in many cases, with the electrodes below the angle of the jaw. They claim to have cured several cases in this way.

Anæsthesia.—Although anæsthesia is intimately related to paralysis, and is due to many different causes of a grave organic character, it is, on the other hand, a symptom to be classed very frequently with the functional neuroses, and as such is often relieved by electrical applications with rapidity and completeness. Every one who has treated many cases of paralysis, ataxia, etc. is fully aware of the temporary relief sometimes given to sensory symptoms by peripheral stimulation, but it is chiefly in the so-called "conduction anæsthesia" that electrical treatment is indicated for its curative influence. In neurasthenic and hysterical cases, and in some cases of poisoning, the persistent anæsthetic symptoms that exist depend, very likely, upon lesions too fine for detection, but which readily vanish before the nutritive improvement brought about by both direct and peripheral stimulation. No other cutaneous irritant can for a moment be compared to electricity for vigorous action and harmless effect. With the electric brush such strong impressions can be made as to influence most powerfully, by reflex action, the peripheral paths of conduction as well as more central parts, and yet in no way affect the structural integrity of the integument.

The object, therefore, of electricity in anæsthesia, and which it accomplishes in an unique way, is "the removal of any affection which inhibits conduction, exaltation of the excitability of the receptive organs, the removal of obstacles to sensory conduction itself, and finally the removal of secondary nutritive disturbances which may be present and interfere with the conductibility of the sensory apparatus."

In some cases of anæsthesia associated with a neurasthenic or an hysterical condition the effects of a local electrical stimulation are not limited to the part irritated. Remote portions of the surface of the body that have been anæsthetic for a long time show a restoration of sensibility, temporary or permanent, and especially have I observed a return of sensation to the mucous membrane of the lips and mouth following brisk external stimulation of the cheek. In anæsthesia dependent upon vaso-motor disturbances more direct applications to the central nervous system, and especially to the sympathetic system, will be found necessary. Associated with anæsthesia (or perhaps it might more truly be said that anæsthesia is itself the associated symptom) is a condition of cutaneous angio-spasm. In the cases of this character that have fallen under my observation perfect whiteness of the skin has been the most prominent symptom. Associated with this pallor we often find pain and a considerable degree of numbness, and, if the difficulty is in the fingers, as is usually the case, decided impairment of their flexibility.

These are the very cases in which, on physiological grounds, electricity would seem to be strongly indicated, and yet in a number of cases treated the results were almost nil. When the disorder is located on the trunk rather than in the extremities, the prognosis would seem to be somewhat more favorable. The liver is believed to be at fault in these cases, and under treatment directed both to the skin and the organ itself we may hope to relieve the condition.

Impotency.—Lost or impaired sexual power may be benefited by electrical treatment, but the application must be administered with judgment and with the understanding that a large proportion of cases will resist every method of treatment. One of the greatest mistakes in applying electricity is the use of currents of too great power; and it is not too much to say that many cases have been permanently injured by strong and prolonged applications of both the galvanic and faradic currents. One is the more likely to be led into this error of too vigorous treatment from the fact that of all parts of the body those portions in the vicinity of the sexual organs, where the electrodes are most frequently applied, feel the electricity least. Impotence, again, is most capricious in the readiness with which it responds to electricity. If it were possible to determine with any accuracy the kind of cases that would be benefited by electricity, it would be a great point gained and save much time and expense to the patient. It seems, however, almost impossible to determine this, and in an experience of twenty years, and in the treatment of hundreds of cases of sexual neurasthenia, I find it impossible in the initial stages of any individual case to offer a confident prognosis. But this much can be positively affirmed: Electricity intelligently used will do more for impotent conditions than any other method of treatment, and, in my opinion, of all others combined, and therefore frequently succeeds after complete failure following persistent efforts along other lines.

In a general way it may perhaps be said that the symptomatic and organic forms of impotence respond with least readiness, and the atonic and psychical varieties most readily, to treatment. The treatment of impotence may be either general or local, or a combination of both methods. In neurasthenic cases both general faradization and central galvanization are of great value, and by their general toning effect upon the nervous system sometimes help these cases without the intervention of local treatment.

The treatment of impotence by local electrical methods is variable, and if internal applications are made the faradic current is to be preferred. Using insulated electrodes, one pole may be placed in the rectum and the other in the urethra. Currents of quantity from short, thick coils of wire are greatly to be preferred for internal treatment, but as these currents of quantity act with extraordinary vigor when applied

directly to the mucous membrane of the urethra and rectum, the utmost caution must be exercised in their use. With one insulated electrode in the rectum and the other externally at the perineum or between the penis and scrotum, very much stronger currents can be used; and the same may be said if one pole is connected with an uninsulated sound in the urethra and the other on the thigh or spine. Purely external applications, one electrode pressed firmly on the scrotum, the other on the spine over the genito-spinal centre, or one on the perineum and the other on the back of the neck, are simple methods of application that not infrequently afford good results. In external applications currents of tension from long and thin coils of wire are mainly indicated.

Drawing off sparks from the spine and from the genital regions by statical electricity is another valuable method. The use of statical electricity is necessarily more than local in its effects, and is really a form of general electrization, but it is especially felt at or near where the sparks are drawn, and by this method very powerful local impressions may be made. In using any form of electricity we have to guard against too long, too strong, and too frequent applications; but we are not to be alarmed if a drop of blood should appear after an internal application, and we are always to abandon, suspend, or modify the applications when they seem to disagree.

On the whole, the faradic current of quantity is, as a rule, to be preferred to the galvanic, although the latter, through its influence over the excitability of the genito-spinal centre and over the tonicity of the arterioles of the erectile tissues, is often indispensable in the treatment.

Neuroses of the Nerves of Special Sense.—Tinnitus aurium is one of the most distressing of the diseases that affect the ear, as well as one of the most difficult of the aural symptoms with which the otologist has to deal. In the galvanic current we have at our command an agent invaluable for diagnostic purposes, and possessing a limited though positive therapeutic value. If the morbid subjective noises are of nervous origin, we may hope for a cure, or at least for an amelioration of the symptoms, through the galvanic current. The healthy auditory nerve reacts in a certain definite way to the galvanic stimulus, but in pathological conditions these reactions are variously changed. The subject of auditory reactions to the galvanic current is, however, too extensive to be discussed here, and the reader must be referred to special treatises. It may be said, however, that the difficulties in the practical application of this method of electro-diagnosis are very great. The normal formula can be obtained only in a certain proportion of cases, and oftentimes only by painful currents; and it must be confessed, even when we obtain apparent deviations from the normal formula, we are not always sure just what such deviation indicates, either

in special pathology or in therapeutics. When the galvanic current (negative pole) is applied to the external auditory canal, certain sounds are excited by the interruption of the current, and especially by its closing, which vary with the strength and continuance of the current and with the individual; yet in the healthy ear the polar effects are never always the same. With the closing of the positive pole, however, there is never any sensation of sound, except in pathological conditions. The polar effect is therefore the leading effect, and the direction of the current through the auditory nerve appears to have no demonstrable influence.

If, when the anode is applied to the external auditory canal in any case of tinnitus aurium, and the current is closed, we obtain a distinct reaction, the probabilities are that the symptom is of nervous origin. On the other hand, if the galvanic excitability of the nerve shows no anomaly, it is probable that the symptom does not arise from a purely nervous cause. In the few instances that have come under my observation when treatment has benefited these cases I have always been able to get distinct anodal reactions.

Impairments of the senses of taste and smell ordinarily recover in time, but we do occasionally meet with cases of complete ageusis and anosmia which persist long after the disappearance of the exciting cause. Influenza is a frequent cause of temporary disturbance of these functions, and the following case is such an excellent illustration of the more persistent character of the symptoms following influenza, and the influence of the galvanic current in relieving them, that it is worthy of record: The case was that of a young lady whose sense of taste had been so completely lost for ten months that it made no difference to her whether she partook of what was most bitter and disagreeable or of the most attractive and delicately flavored dishes. In January of the previous year the patient suffered from a sudden and severe attack of influenza, followed by fever. In March a sudden attack came on, resulting not only in a loss of the sense of taste, but also in the loss of the sense of smell. It was evident that all the gustatory fibres were involved, for, however completely the various portions of the tongue and surrounding mucous surfaces were tested, it was impossible to elicit the slightest suggestion of the existence of this special function. To the influence of the galvanic current the vital function of the nerve responded but faintly—so faintly indeed that it was hardly recognizable to the sense of the patient. After two or three applications, however, the metallic taste was very quickly and distinctly appreciated, and in about two weeks the lost function was quickly and permanently restored.

Diseases of the Skin.—Dermatological diseases, so far as they are amenable to the therapeutics of electricity, may properly be regarded as of nervous origin. Certain it is that diseases of the skin, taking

the cases as we find them, are not readily amenable to electricity, and yet that many cases are greatly and quickly benefited by this treatment is within the experience of every one who has made much use of the current for this purpose. Both forms of dynamic electricity exert a more or less favorable influence in skin affections of the nervous type, but the galvanic is greatly to be preferred. The superiority of galvanization over faradization lies in the fact that the former alone exerts the necessary electrolytic influence, and influences far more powerfully than the faradic the central nervous system. Central galvanization alone not infrequently proves of great service in some skin diseases—in prurigo and chronic eczema especially. This method of treatment alone, without local applications, electrical or otherwise, has undoubtedly been the means of curing some and relieving other cases of long-standing eczema. In other cases, however, it is impossible to dispense with applications directly to the diseased surface. An adjustable electrode, preferably the anode, two or three inches in diameter, may be placed over the trunk of the nerve the branches of which supply the area mostly affected, while the cathode should be applied directly to the diseased surface.

How much advantage is possessed by this method over the method of applying both electrodes directly to the diseased parts I am not prepared to say. I have seen good results quickly follow both kinds of application, but whichever method is adopted, it is to be borne in mind that the cathode, from its more vigorous and distinctive electrolytic properties, is generally to be preferred for local effect. The electric brush with the faradic current is a not unimportant procedure in some conditions. It is more or less painful, and is chiefly indicated in cases in which there is profound itching irritation, where I have often found it far more efficient than ordinary electrodes. Applications which in health would be absolutely unendurable, are in some cases of eczema positively agreeable. Some cases of severe itching also are temporarily as well as permanently relieved in this way, although local applications of the galvanic current usually afford better results.

My own personal experience has been most satisfactory in the treatment of herpes zoster by the galvanic current, whether its seat be the head, trunk, or extremities. Where there is a rheumatic or neuralgic diathesis we are liable to have herpes, and indeed any cause, probably, which weakens the vigor of a nerve-trunk or its cutaneous branches may be followed by the characteristic pains of this disease. Both currents, the galvanic and faradic, are likely to do good when the pain is confined to the trunk or the extremities, although the former is the most efficient.

In herpes frontalis, however, my experience in a considerable number of cases convinces me that the galvanic current alone can be relied

upon to give relief. Perhaps if it were possible to apply the faradic current with the same strength that it is applied to other portions of the body, it would be of the same service. It is impossible to do this, for the head is so extremely sensitive to the induced current that only the very mildest applications can be given. Besides relieving the pain of herpes, electricity undoubtedly somewhat shortens the acute stage, and by breaking the force of the disease tends to modify the scarring.

Nervous Diseases of the Larynx.—From the absence of all inflammatory action and the readiness of their recovery under electricity we are justified in regarding a considerable number of cases of aphonia as of nervous origin of a functional character. Bilateral paralysis of adductor muscles acting upon the vocal cords is regarded as most frequently associated with aphonia dependent upon hysteria and debility. In these cases electricity does much good, both through general and local treatment. Simple external treatment is often very efficacious in aphonia, and the faradic current in these hysterical and nervous cases is quite as beneficial as, if not more so than, the galvanic.

In cases, however, which resist external applications the electrodes should be applied directly to the vocal cords. The electrode should be kept in the larynx for three or four seconds and a succession of short rapid shocks passed from the interior to the exterior. In the internal treatment as in the external both currents have been used with success, but the faradic current is quite as efficient as the galvanic, and is perhaps to be preferred.

Nervous cough is another symptom which has often yielded to local and central applications of the galvanic current.

Electricity in Gynecology.

Until a recent period the advances in the therapeutic uses of electricity were more especially along the line of those distinctively nervous affections that were neither specific nor structural in their nature. Cases of this latter type have always yielded but meagre results under electrical treatment, and I do not know that any competent authority seriously claims for electricity in most cases of structural disease of the central or peripheral nervous system more than temporary and palliative effects. And yet those who, arguing on the side of their prejudices or out of the fulness of their ignorance of the subject, ascribe to electricity a very low place in therapeutics do so mainly on the basis of its failure to cure a class of conditions incurable by any method of treatment. The statement that as a therapeutic agent "the effects of electricity are limited" must indeed seem a rash observation to those who have repeated evidence of the wide range of its influence in the relief of nervous symptoms, and especially so to those who have witnessed the really remarkable relief so often afforded by both extra- and intra-uterine

applications of the galvanic current. When a man possessed of the experience of Keith of Edinburgh can say that many are prejudiced against electricity because they consider it quackery, and know nothing about it; that his confidence in its power to relieve disturbing symptoms of fibroid tumors and to cure many chronic inflammatory conditions of the pelvis continues to increase; and that he has no fears for the future of electricity,—we have testimony that must greatly outweigh assertions and opinions that are purely negative. In a recent and animated discussion of the subject at the Société de Chirurgie of Paris equally favorable opinions were advocated by the majority of those engaged in the debate, and the strength of these opinions was accentuated by the fact that the majority of those who hold them are signally distinguished as laparotomists.

Static electricity has a limited range of usefulness in diseases of women compared with the two forms of dynamic electricity. By the ordinary methods of its application it acts as a stimulant and tonic, and is therefore of service in amenorrhœa and in the various constitutional disturbances so generally associated with uterine disease. In dealing with the other two forms of electricity I do not propose so much to give the results of my own experience in gynecological electro-therapeutics as to allude briefly to some points in the rationale of its effects, and to offer some practical observations on the methods to be employed.

The effects of the faradic current are mainly mechanical, and according to the construction of the helix and the length and thickness of the wire do we measure its action on the muscular tissues of the uterus. Applied directly to the uterus of animals in physiological experiments, the organ visibly contracts, although not to such an extent as do the intestines, which on application of the electrodes can be seen to draw up gradually very much after the manner of a woman's work-bag. Its action on the smooth muscular fibres of the human uterus when applied therapeutically is analogous to that of ergot, although manifestly more prompt and energetic, especially under the influence of the positive pole, which possesses a much greater power over the involuntary muscles than the negative. It is a current of alternation, of constant closing and breaking, hence it produces a sort of interstitial massage, heightening the activity of the circulation, accelerating absorptive processes, and influencing favorably the nutrition of parts.

Faradization by its power over muscular contractions sensibly increases temperature. According to the chemistry of the development of heat during muscular contractions, muscular work is the result of the decomposition of nitrogenous substances, and the muscles grow at the same time that they work and develop heat. That the value of the faradic current is more limited than the galvanic in the treatment of uterine disease must be immediately manifest to all who appreciate

the difference between them, but in some conditions which come within the range of its physical and physiological activities the faradic current may exceed in efficiency the galvanic. By its direct excitation of the smooth muscular fibres of the uterus we are enabled to combat that stasis of the circulation which is the beginning of uterine inflammation.

By this method we obtain a veritable interstitial massage that is potent in overcoming the primary inertia of the organ, and in preventing an arrest of retrograde metamorphosis, through which comes subinvolution with its inevitable and persistent sequelæ. In its purely local influence, then, faradization would seem to be preventive rather than curative as it relates to uterine disease; or, rather, it is preventive so far as concerns the later condition of uterine engorgement, and curative only in its initial stage. When the processes that go to make up the graver and more chronic diseases of the uterine parenchyma and its lining membrane have continued a long time, as is usually the case when medical interference is sought, the simple mechanical effects of the faradic current would be altogether misdirected.

Here we resort to the electrolytic influence of the galvanic current, or rather to what may be more fitly termed its galvano-chemical cauterizing effects, through which are destroyed the granulations and fungoid growths of the diseased mucous membrane. By the interpolar influence of the current we correct a languid nutrition and hasten the absorption of exudations.

In considering the many excellent and curative effects of internal applications of the faradic current we should not lose sight of the fact that external applications alone are frequently most efficient methods, especially for the relief of the disorders of menstruation. When we remember that in young girls it is neither desirable, nor in many cases possible, to administer internal treatment, the importance of having at command external methods that may prove serviceable is readily appreciated. Electricity is not merely a stimulant, but may be made to act as a powerful constitutional tonic. Under certain conditions its action also is sedative, and these effects of sedation and improvement in nutrition are far more important than its stimulating effects. As in many of the diseases peculiar to women, it is of prime importance to improve both the local and general nutrition and to produce not only stimulating but sedative effects, the method of general faradization plays no unimportant part in the treatment of diseases of women, and especially, for reasons just stated, in the treatment of the disorders of menstruation occurring in young girls.

Electricity is no exception to the general law that in order to obtain the constitutional tonic effects of a remedy the whole system must be brought under its influence. It is not a whit more irrational to expect one to appreciate the full tonic effects of cold water by washing one

arm only than it is to expect the full effects of electricity by using it locally. Experience here confirms analogy, and teaches that the constitutional effects of electricity can only be obtained by making the applications all over the person and to the central nervous system.

The results of these methods are variously modified according to the conditions of disease or special idiosyncrasies of the patient. Many, and perhaps the majority of, patients subjected to thorough general applications experience a feeling of enlivenment and exhilaration. In others the tendency may be to sleep, and in such cases the patient should be permitted, and even enjoined, to quietly repose for some time. Because of this disposition to sleep which is so often observed it becomes in many cases desirable, especially when insomnia is present, to administer the applications at night before retiring. The relief from indefinable nervous pains and from general and local weariness is a very agreeable temporary effect of general faradization. Sometimes this feeling of relief lasts for several hours, and at other times for a much shorter period, but in either case persistent effort will, as a rule, result in more or less permanent benefit.

Now, in those cases of amenorrhœa, dysmenorrhœa, or menorrhagia where it is impracticable to attempt internal methods of treatment we can with confidence offer a favorable prognosis only on the assumption that no serious pathological condition prevails, and in the vast majority of cases of amenorrhœa occurring in young girls it is not at all probable that any such important pathological condition exists. Most of these cases are probably associated with, and more or less dependent upon, chlorosis or nervous exhaustion, and the important thing is not to specially stimulate the uterus, but to change the constitutional condition which is the cause of the suppression of the function. Accordingly, the treatment by general faradization, combined with such internal medication as may be specially called for, is generally sufficient without applications directly to the uterus. Indeed, the majority of cases of functional disease of the uterine organs require general as well as localized electrization.

In any case of amenorrhœa where the patient is weak and anæmic, with other and well-understood evidences of malnutrition, the faradic current is strongly indicated over the galvanic. As already stated, the applications should be general, although the local treatment, when permissible, is always in order and undoubtedly hastens the desired effect. Localized galvanization is, as a rule, not only not indicated in such a condition, but in many cases, as I have had abundant occasion to observe, tends to induce a condition of nervous irritation that is exceedingly unpleasant. In amenorrhœa either pole when applied to the uterus may be followed by the best results. The negative, in the subjective sensations that it causes, is the stronger, but the positive is decidedly prefer-

able in some cases, because its tendency is to more readily contract the involuntary muscular fibre. In the treatment of neuralgic dysmenorrhœa, where the faradic current is sometimes of value, the positive pole locally applied is undoubtedly preferable. On physiological grounds alone this conclusion might readily enough be reached, but unfortunately electro-physiology is as yet but a very uncertain guide in many cases. I have therefore for years carefully observed and as carefully recorded the differential effects of the poles in this condition, and have become convinced that the average results are superior when the positive pole is used.

On the same principle that we use general faradization in cases of amenorrhœa associated with, and perhaps dependent upon, a weak, chlorotic condition of system, we make applications of it where similar symptoms are associated in the menorrhagic subject. In not a few such cases I have known simple external treatment by this method to be followed by complete and permanent cessation of the excessive flow, and a corresponding improvement in appearance and strength.

The local treatment of the uterus and its appendages may be either external or internal. The external treatment consists simply in placing one pole in front, over some portion of the abdomen, according to the indications of the case, and the other over the lower lumbar region. This method is frequently of great service in the disorders of menstruation, and in the case of virgins should certainly be attempted before resorting to the internal method.

The localization of the current in the organ in this way is, of course, only partial, and far less effective than internal applications; while the benefit derived is undoubtedly in part due to the effects of the current, at least of the galvanic current, on the lower part of the spinal cord and the abdominal ganglia of the sympathetic.

The internal treatment of the uterus and ovaries by the faradic current may be effected in two special ways. 1st. By the uni-polar method. The internal electrode may be applied either to the cervix uteri, to the interior of the uterus, or in the rectum, while the other is applied externally, either at the nape of the neck, near the sixth cervical vertebra, over the lumbar region, or, as is most generally the case, over the abdomen. Applications to the cervix are made by means of an insulated electrode with a metallic bulb, or, instead of the bulb, small plates may be used to clasp the os. The vagina may be treated by a straight or slightly curved metal electrode. It is an interesting and important fact to be borne in mind that internal are relatively far less painful than external applications. Very many, therefore, in first attempting this method of treatment are surprised that the sensations under the broad surface of the external electrode are complained of more than those at the point of contact of the small internal electrode.

In uterine displacements the faradic current by the uni-polar method has accomplished some good. The rationale for its use is indeed so clear that from the standpoint of theoretical considerations alone one might be pardoned for regarding it as almost a specific in this class of cases. The two most important factors that make up the value of electrical applications in displacements are probably the hyperæmia, and especially the contraction of muscular fibre, that follow its use; and as the contraction of a muscle determines the amount of its nutrition, it follows that if a current of electricity is localized in a given point of the uterus, that part will contract, its nutrition be improved, and at the same time counteract any flexion in the opposite direction. It must be confessed, however, that even in experienced and competent hands the results of electrical treatment in this special field have not equalled the brilliant promises of some of its ardent advocates.

The simplest, and probably least efficacious, method is to introduce one electrode behind the os uteri, while the other is applied externally over either the pubes or sacrum. A more effective localization of the current is accomplished by introducing one electrode into the uterus, while the other is placed externally; but more effective than this is the internal use of both poles, still by the uni-polar method. In cases of anteflexion one pole, the curve of its stem corresponding to that of the sacrum, is introduced into the rectum up to the point nearest the posterior wall of the uterus. In this way the current is quite accurately localized in the posterior uterine wall, causing contraction and improving nutrition. In retroflexion the first electrode, instead of being passed into the rectum, is introduced into the bladder and applied to the anterior wall of the uterus. When the faradic current is used—and this form is chiefly indicated—the relative position of the two poles would seem to be of no special importance, although for the intra-uterine electrode the anode may be preferred, on the theory that it has a greater power over unstriped muscular fibre. Tripier, however, recommends that the negative pole be placed in the uterus. The pain is sometimes considerable, and is due to two causes: first, the concentrated action of the electricity on the mucous membrane; second, the contraction of the uterine fibres. In other cases very little discomfort is produced. By beginning with a very weak current and gradually increasing it, a much greater strength can be endured than if this precaution is not observed. In this connection it may be pertinent to the subject to say that when voluntary muscles are subjected to the action of the poles of either a galvanic or an electro-magnetic battery, contractions instantly occur. These contractions continue, as is well known, during the passage of the faradic current, but quickly relax after the first shock of the galvanic. When, on the contrary, involuntary muscular fibre, of which the uterus is composed, is subjected to

the influence of the electric current, movements are not induced until a certain time after the tissues have been acted upon. The movements thus excited continue for a time after the cessation of the current, and do not, as in the case of voluntary muscles, cease as soon as the electrodes are removed. The most efficient action, however, of the faradic current upon the uterine tissue is through what is known as the bi-polar method. In this method both poles, the positive and negative, are combined in a single electrode, constructed either for intra-vaginal or intra-uterine applications.

The physiological and therapeutical effects of the faradic current vary greatly according to the construction of the helix, and many of the machines that are sold for medical purposes are of limited value. The galvanic current, on the contrary, varies but little in its sensible effects whatever form of battery is used, and in the selection of an apparatus the question is not as to the character of the current, but relates more to matters of convenience and constancy. The two forms of faradic apparatus in general use are what are termed the separate and the continuous coil. The separate-coil apparatus is almost universally composed of only two distinct coils, the primary and the secondary, although those who use electricity to any great extent in gynecology utilize a third coil of exceedingly long and fine wire. The primary coil, with its short, thick wire, gives a current of exceedingly low tension, but of considerable quantity, while the longer and thinner the wires, up to a certain point, the greater the tension and the less the quantity.

Externally used in the ordinary methods of electrization, the currents of quantity produce little if any effect. Their tension is so low that it is with difficulty that the current can force its way through the great resistance of the skin. The currents of tension, on the contrary, readily overcome the resistance of the skin, and are adapted for all external treatment. When, however, we apply the currents internally, even by the uni-polar method, a very great change is observed in the efficiency of the currents of tension and of quantity. The former, even if used with all the power that an ordinary battery is capable of giving, seldom causes pain or very violent contractions, and after a few moments of application absolutely no sensation may be experienced, and both physician and patient may be in doubt whether any electrical action is taking place. Just as the current of tension acts with apparently decreased vigor when applied to the vagina, uterus, and other internal parts of the body, the currents of quantity seem to double their energy and to produce both sensation and contraction of a very positive character. Substitute for uni-polar the bi-polar method, and the contrast is far greater. A current of quantity which when applied externally makes absolutely no impression, and even when applied internally by the uni-polar

method is felt with little vigor, causes, when passed through the poles of a bi-polar electrode, the most vigorous contractions and positive sensations. The continuous-coil apparatus, in that it affords a wider range of electrical effects with its four distinct qualities of current of quantity and tension, is to be preferred in gynecology as well as for general therapeutic purposes.

These currents of quantity, when applied internally through a bi-polar electrode, should be used with caution. The extraordinary vigor with which they act upon the vagina, uterus, rectum, or bladder, compared with the exceeding mildness of their action when applied externally, will hardly be credited without actual demonstration of the fact.

The physiological effects of the current of quantity indicate in a measure what its therapeutical effects should be, and also the pathological conditions for which it should be used. Primarily, it is a powerful stimulant and tonic for muscular fibre, and when there is defective muscular contraction it is often used with the most marked success. In post-partum hæmorrhage it is invaluable, and has the advantage over ergot that it acts simultaneously and can be readily graduated, so that the power put forth shall be just sufficient to accomplish the object sought. It is in the beginnings of uterine disease that the faradic current is especially valuable, and if used promptly and judiciously after confinements and abortions when subinvolution is threatened it will prevent much subsequent trouble. "We no longer ignore the fact to-day that the great majority of uterine inflammations, probably of septic origin, are due most frequently to an arrest of the retrograde metamorphosis of the uterus, that they are created entirely by uterine subinvolution, and that the circulatory troubles, characterized by congestion and stasis, preside over their initial evolution. If the physician interferes, then, by removing obstruction and sepsis at the same time, producing a passing hyperæmia, a sort of circulatory drainage, if he combats the primary inertia of this organ, the slowness of the circulation of which gives rise to all the subsequent inflammation, he puts in an excellent treatment which prevents and cures at the same time. Such is the rôle of faradization, which, applied in the uterus in the proper manner, preceded and followed by an antiseptic injection, produces a sort of interstitial massage, provokes the contraction of all the smooth muscular fibres, excites and hurries the circulation, accelerates the absorption of exudations, and so corrects a languid or perverted nutrition."[1]

In fully-developed subinvolution the benefit that follows bi-polar faradization with the current of quantity has, in my own experience, been positively and promptly indicated. The current of tension from the long, thin wire of the helix possesses an altogether different func-

[1] *Chronic Metritis*, by George Apostoli, translated by A. Lapthorn Smith.

tion. It possesses but a limited influence over the contractions of the uterine tissues, and is manifestly inferior to the current of quantity in its influence over the circulation. It affects the nervous system powerfully, however, and possesses an influence over pain that is in some instances little less than magical. The best results that are obtained in uterine and ovarian pain undoubtedly occur in cases unassociated with organic lesions. In these cases the relief is often prompt and permanent, but even in severe forms of pain dependent on or associated with structural uterine disease, the relief afforded is often very great. In cases of ovarian pain it is manifestly impossible in many cases to say whether the ovaries themselves are diseased or not, and it is most unfortunate that they should ever be removed without first testing the efficacy of either the galvanic or the faradic current of tension, both of which play such an important rôle in the relief of pain. It is within my own experience that after both ovaries had been removed for the relief of ovarian pain, but without avail, the galvanic current succeeded in effecting a complete and permanent cure.

Valuable as is the faradic current to prevent, and even cure, uterine and ovarian disease, it occupies in many respects a quite different field from that of its fellow, the galvanic current. In the use of the first named we depend mainly upon simple mechanical and stimulating influences, while in the use of the other we rely upon its electrolytic influences, or rather on what may be more fitly termed its galvano-chemical cauterizing effect, through which are destroyed the granulations and fungoid growths of the diseased uterine mucous membrane. Just as the positive pole of the faradic current has an action of its own superior in effect to the negative in causing uterine contractions, so the positive pole of the galvanic current has an action peculiar to itself. Here oxygen is generated and acids accumulate, which render this pole directly hæmostatic. It is therefore indicated in all hæmorrhagic conditions, as well as where there exists an excess of the natural secretions. Owing, also, to the greater retractibility of cicatrices following positive galvano-cauterization, the results are more lasting in the treatment of fungoid growths or vegetations than could possibly be the case with the negative pole.

At the negative pole, on the contrary, the alkalies precipitate, imparting caustic properties and causing effects fluidifying rather than hæmostatic. The absorptive process is undoubtedly more active under this pole than under the positive, and is especially indicated in indurated chronic metritis and for the resolution of fibroids.

That the galvanic current often completely dissipates fibroid tumors of the uterus few will, I believe, affirm. In the treatment of scores of fibroids on the external surface of the body I have never yet seen a single instance where one of them completely disappeared. As a rule,

the reduction is comparatively slight, unless suppuration is excited, which may be easily done. External fibroids are simply unsightly, and for this reason we desire to be rid of them, and as it is not possible to obtain more than a reduction in size, the knife is to be preferred and electrolysis has fallen into disuse. We treat uterine fibroids, on the contrary, not because they are unsightly, but because associated with them are a train of symptoms sometimes of the most distressing character. These symptoms can, it is believed, be relieved to a greater or less extent by electrolysis, and sometimes so completely relieved as to lead to the belief, so far as the patient is concerned, that the tumor has entirely disappeared. In the great majority of cases, however, it is simply a symptomatic cure. The tumor is still there, but reduced in size, and so far as pressure upon surrounding parts is concerned, or any hæmorrhagic tendency, is entirely harmless. I am a firm believer in the great utility of the galvanic current in the thickenings and infiltrations resulting from inflammation of the pelvic cellular tissue. For the absorption of old exudations in other parts of the body this treatment has long been used with excellent results, and in pelvic exudations the results are even better. I have seen the treatment, persistently carried out, result not only in the absorption of large pelvic deposits, but in the cure of the most obstinate and severe sciatica and in the restoration of power to partially paralyzed limbs. In such cases both sciatica and paralysis are caused, undoubtedly, by pressure upon the pelvic floor, and can be relieved only through the dissipation of the morbid products.

There are two methods of action through which we obtain results from electrolysis. The first and most apparent is the absolute destruction of tissue which takes place at the time of treatment. Some suppuration may follow, and thus, by an actual loss of substance apparent to the sight, the tumor decreases in size. If, however, these were the only active forces in the electrolytic process, the method would lose much of its effectiveness.

If this be not so, how can we account for the many well-attested cases where morbid growths have entirely disappeared under simple external applications? Herein is the difference between the electrolysis of organic and inorganic substances. In the electrolysis of inorganic substances the effects cease as soon as the current ceases, the substances remaining in the condition that the current left them. The electrolysis of organic substances, on the contrary, starts a process that continues long after the current ceases to flow. Besides this subsequent effect, the current penetrates the tissue and induces various important changes beyond and beneath the eschar, and these combined agencies do far more, in many cases, to diminish the size of morbid growths and prevent further development than an actual destruction of a limited area.

The methods and technique of gynecological electro-therapeutics have been only recently developed and are still developing. Most extravagant and unreasonable estimates of its efficiency have been held by the more enthusiastic, while the extreme conservatism of many eminent gynecologists would relegate it to a comparatively unimportant position in the treatment of uterine and ovarian disease. Adverse opinions upon this interesting subject, when based upon thorough and well-directed experience, are of value and altogether indispensable; but when there is no experience behind opinion, or an experience that has been guided by no clear insight into the law of physics and technique of methods, opinions, either for or against, are manifestly worthless.

Thus would I estimate the opinion of men, otherwise most competent in the line of gynecological work, who discourage the use of electricity by the newer methods for the relief of conditions in which the curette or knife alone were formerly supposed to be efficient. These newer methods, first introduced, as is well known, by Apostoli, are special and unique, and ignorance in their use must account in some measure for the failures to obtain the usual results, and necessitates a brief physical introduction and a description of apparatus and secondary appliances essential to conduct experiments in this direction.

1. *The Battery.*—At the outset let it be understood that so far as the physical and physiological and chemical effects of the galvanic current are concerned it is immaterial what form or size of cell is used. In view of the discussions that even now arise in medical societies, among men who are supposed to be proficient in regard to this subject, concerning the superiority of the effects of this or that element, this statement is a pertinent one. No matter what the origin of the galvanic current—whether from large or small cells, from the voltaic pile or from the huge dynamo with which our streets are lighted—the kind of work is always the same according to the electro-motive force and the resistance in the circuit. Electro-motive force is one, and Ohm's law is our only and infallible guide, and attempts to prove the superiority of this or that kind of element, except on the ground of constancy or convenience, is useless. While this is true of the galvanic current, it is by no means so with the faradic, the causes of which will be found explained in the previous pages of[1] this article. To do thorough satisfactory work with electricity in gynecology the practitioner should have at command an electro-motive force of about seventy-five volts. He can do with less than this in most cases, but occasions occur when the whole number will be required. As constancy is a very essential point in the treatment of this class of cases, the ordinary single-fluid cells should not be selected. As they have but little internal resistance and a fair electro-motive force, it might be supposed that they would answer

[1] See p. 138.

every purpose; but as they have no satisfactory provision for depolarization, the hydrogen that collects upon the plates soon lessens the current to the detriment of the treatment. For constancy the Daniels is the ideal cell. It gives an electro-motive force of one volt, and even when short circuited will retain its constancy for a length of time sufficient to utterly destroy most other batteries. The fatal objection to it, however, is the readiness with which the liquids in the cells are diffused through the diaphragm, requiring frequent recharge. The Leclanché —or the Law cell, which is a modification of the Leclanché, and in some respects to be preferred to it—is not constant in the sense that a Daniel's cell is, or a Grove or a Bunsen. If left short-circuited for any length of time through carelessness or accident, the owner may return to find his apparatus a wreck from which no current can be obtained. Used, however, through a high resistance, such as the human body, it retains its constancy for several hours, and even when finally weakened it regains its strength after a short interval of rest. With proper care it retains its vigor of action for many months, and in the case of the larger-sized cells for two years or more with very little attention. It is therefore for therapeutic purposes quite unapproached by most other forms of apparatus, and can confidently be recommended for the four qualities of constancy, strength, durability, and cleanliness.

Small Leclanché batteries for portable use have been constructed, but have failed to answer the purpose, for their very compactness has rendered them readily polarizable and easy to get out of order through secondary action. For portability combined with constancy the chloride-of-silver batteries can be highly commended. They are, however, costly, and another drawback is their extraordinarily high internal resistance, which necessitates a very much larger number of cells than other forms having only the same electro-motive force. As the Leclanché cell has an electro-motive force of one and a half volts, fifty of them would fully answer for every gynecological purpose.

By all means select large cells for office use. Holding a larger amount of material, they require charging less frequently and polarize with less readiness. Added to this, they are cheaper in proportion to the work they do, and are far less liable to get out of order.

Mention should also be made of the Edison electric-light current. It is a current of low tension, not exceeding 125 to 200 volts, and is therefore devoid of danger; furthermore, as the internal resistance is slight, it can be used for the purpose of galvano-cauterizing as well as electrolysis. Arrangements are now perfected by which this current can be conveyed direct from the dynamo into one's office and utilized for all practical work. It is readily appreciated that with a current of such a considerable voltage some resistance should at all times be kept in the circuit.

2. *The Milliampèremeter.*—The milliampèremeter is to the physician using electricity what the scales are to the apothecary dispensing his drugs; and while this instrument of precision is by no means always essential in every electro-therapeutical application, it is safe to say that electrical treatment in gynecological cases could never have advanced as it has done had it not been for this great improvement in the method of electrical measurement. Mathematical precision has been substituted for the uncertain and generally inaccurate estimates of current-strength in internal applications, and the operator is now able to compare day by day the varying potentials employed, and to put in definite language instructions as to further treatment to whomsoever he may wish permanently or temporarily to confide the case.[1]

3. *The Rheostat.*—There are two principal ways of gradually increasing and decreasing the strength of the current without interruption, the first and most common method being the ordinary current-selector attached to the element board of most stationary batteries. It is by no means the most certain or easy method, and in the majority of batteries as arranged it is impossible to manipulate these selectors without occasionally interrupting the current. It is therefore safer and more convenient to possess some form of water rheostat or some one of the various current-controllers in which the intercellular resistance is a solid instead of a fluid.

Of the water rheostats, the Bailey current-controller is perhaps as good as any. It is an improvement on the ordinary water tube-and-rod rheostat that has been in common use for so long a time in that it is possible to approximate more nearly the maximum meter-measurement that the whole number of cells employed is capable of giving. Instead of the rod, we have four broad carbon plates, which when immersed give a large surface contact, and which when lowered into or raised from the water increase or decrease the strength of the current through a very wide range of resistance.

4. *Internal Electrodes.*—The electrodes for internal use should be of two kinds—for extra- and intra-uterine applications. For extra-uterine applications within the vagina the electrodes consist of a ball or disk of brass or carbon mounted upon a long insulated stem. In using the faradic current these electrodes are not necessarily covered by any protecting material. Applications of this current through the mucous membrane of the uterus or vagina cause no more sensation with uncovered than with covered electrodes. With the galvanic current, however, it is very different, and the matter of covering is of considerable importance. Ordinary absorbent cotton answers very well, and is much to be preferred to sponge; but the best protection to the mucous tissues is a carefully adjusted covering of sculptor's clay held

[1] For further description of the milliampèremeter, see p. 139.

in place by any light material, such as the lightest form of unbleached towelling or tarlatan. The carbon electrode is to be used in connection with the positive pole, and through both electrodes, when protected in this way, much stronger currents can be borne without injuring the tissues than if used without such covering.

As regards the intra-uterine electrode, an ordinary Sims sound can often be used with much satisfaction, provided the introduction is made in the Sims position. In the dorsal position the shaft or stem in contact with the vaginal walls should of course be insulated ; otherwise a part of the current will be conducted away before the intra-uterine portion is reached.

No matter, however, what the method of application, insulation is to be preferred, and in the various forms of intra-uterine electrodes found at the instrument-maker's the uninsulated portion varies from half an inch to two or more inches, suitable for applications to the different parts of the endometrium in detail. When the positive electrode is used internally, it should of course be of platinum or some other material that equally resists the oxidation that takes place at this pole. It has of late been found that by subjecting steel to certain processes it can be rendered unoxidizable, and as the cost is much less than platinum, it becomes a desirable substitution.

Other sounds, uninsulated except by a movable sheath made either of hard rubber or glass, are preferably used by some, and while they enable one to extend or decrease the area of the uninsulated and active part of the electrode at will, there are certain disadvantages connected with them. It is impossible, in the first place, to extend the insulating sheath beyond the curve of the instrument, and they are more likely to remain unclean.

5. *External Electrodes.*—With every appliance complete and of the best—battery, internal electrodes, and instruments of precision—one will yet fall far short of accomplishing the best results in the treatment of uterine disease without careful and correct attention to the character of the external or cutaneous electrode.

To Apostoli is due the credit of reducing to a system and practically applying the simple principle of physics familiar to all, that the larger the area the less the resistance. In all electro-therapeutical procedures the skin is the great obstacle to the efficiency of electrical action. With the ordinary sponge electrode, offering an immense resistance, it was not only impossible to obtain from any reasonable number of cells a current sufficiently strong to do effective work in many internal diseases, but the burning and pain under this external electrode readily became unbearable. The milliampèremeter, accurately registering the strength of the current, enabled us to appreciate the fact that it varied immensely according to the size and quality of the electrodes,

even although the number of cells in the circuit remained the same. To overcome in the least painful manner this great cutaneous resistance Apostoli, as is well known, suggested electrodes of sculptor's clay.

Sculptor's clay is readily obtained almost anywhere, and with a little attention to detail each one can prepare these electrodes for himself and with but little expense. In the selection of the clay be careful that it is free from all admixture of sand, and combining with the utmost plasticity as little stickiness as possible. The character in this respect of the various kinds of clay varies considerably, and a poor selection may cause unnecessary discouragement. The clay should be soft, but not very soft. Its conducting power depends, of course, upon the amount of water absorbed. If the mass is too hard, there will be manifestly less readiness of conduction; if too soft, it becomes nasty and difficult to keep in place. It should be just plastic enough to be readily moulded to the inequalities of surface, and to impregnate every pore without dropping apart or spreading beyond the limits intended. If successfully made, so that the finger can penetrate it without effort, it can be moulded and used without any covering whatever. As generally used, however, it is enveloped by the thinnest kind of towelling, or, better still, by coarse tarlatan, through the meshes of which it can easily transude, and which, when the clay would be too soft to use without a covering, keeps it in compact form. A suggestion of Dr. A. Lapthorn Smith is that a little glycerin, through its affinity for moisture, will when added to the clay greatly aid in keeping it soft and pliable. When not in use it is necessary, in order to preserve the humidity of this electrode, to keep it covered with oiled silk or rubber cloth. When ready for use the mass should be of uniform thickness, neither too thick nor too thin. If the former, it will offer an unnecessary resistance and weight; and if the latter, there is the risk, in the slight spreading that inevitably occurs, of the metallic disk which covers the back of the mass of clay, and through which the electricity is conducted to the clay, penetrating through the mass and coming in contact with the skin. These electrodes vary in size, according to the strength of current desired, from a few inches square to dimensions sufficient to cover nearly the entire abdomen.

6. *Operative Procedure.*—Intra-uterine galvano-cauterization, as well as the electrolysis of fibroids, requires currents of high tension. Bearing in mind this fact, the necessity of careful deliberation in carrying out the details of these operations becomes sufficiently evident. In applications, whether extra- or intra-uterine, the dorsal position is generally sufficient, and is indeed to be greatly preferred. Sometimes, however, the difficulty of introducing the intra-uterine electrode is so great, and perhaps insurmountable, that the Sims position is found necessary—a position that is by no means so favorable for an easy and

satisfactory adaptation of the cutaneous electrode as the dorsal. The abdomen is for many reasons the best position for this electrode, and, whether consisting of clay, of absorbent cotton, or other material, should be carefully adjusted and a few moments allowed for the skin to become thoroughly moistened before the introduction of the active electrode. Everything being in readiness, the current should be gradually increased, either by means of the current-selector or rheostat, until the milliampèremeter indicates the desired strength.

If the element-board is constructed properly, the current can be increased cell by cell with little if any danger of interruptions, and with the assurance that we are utilizing the total strength of the cells in the circuit. For absolute safety, however, the rheostat is to be preferred. The disadvantage of the water rheostats in common use is that, unlike the first method, we are unable to utilize the full strength of the cells in operation. This defect is in a measure overcome by the dry rheostat, several kinds of which are now obtainable.

Thorough antisepsis of both the hands and internal electrode is recommended. The current itself, however, is a good antiseptic, and experience shows that there is but little if any danger to be feared even if these thorough antiseptic measures are not adhered to. "The whole operative procedure," says Apostoli, "may be summed up in a good hysterometry, the operation itself being nothing more than a therapeutical passing of the sound where all traumatic action (except in the case of puncture) should disappear in order to give place to the highest degree of electro-chemical action. Manifestly, there can be no absolute standard as to the dose of electricity by any method or in any disease. Individuals vary immensely in their susceptibility, although the relative variation in the dose necessary to give, in the use of these intra-uterine electrodes or in the treatment of fibroids by puncture, is not so great as it is in external and purely non-surgical treatment. In the treatment of fibroids and in the galvano-chemical cauterization of the endometrium when we desire the destructive action of the current in the treatment of granulations and fungoid growths, a certain amount of work has to be done, and this requires a definite strength of current. In beginning these intra-uterine applications thirty or forty milliampères are often sufficient, to be carefully increased according to the susceptibility of the patient, until 100, or even in some cases 150, milliampères are reached. It is in the chronic catarrhal diseases of the endometrium, as well as in later pathological conditions, when the uterine parenchyma becomes involved, that these intra-uterine applications of high tension are particularly applicable; and much well-authenticated experience clearly shows that in many instances it possesses advantages over caustics, the knife, or the curette. A most important advantage over caustics or the galvano-cautery is that its

dose can be given with mathematical exactness, and according to the pole employed it is possible to obtain effects that are hæmostatic or congesting at will. Again, so gradually can we work up to the effect desired that the operation is devoid of those sudden and severe effects that are inevitably associated with other methods. While lesions of the uterine mucous membrane are amenable to the action of either pole according to the existing pathological condition—in the hæmorrhagic and profusely catarrhal forms the positive, and in others the negative pole—there finally, in many cases, comes a condition of the substance of the uterus which calls alone for the effects of the negative pole. These are the cases of chronic parenchymatous metritis which have baffled so often the best efforts of gynecologists by the old methods, but which bid fair to yield more readily to the new. In those cases of interstitial metritis which have reached the stage of induration some remedy that will act in a powerfully stimulating and derivative manner, that will excite the feeble and almost extinct circulation, hastening nutritive changes and quickening absorptive processes, is imperatively demanded." Such a remedy, says Apostoli, is found in "the negative pole, basic, diffluent, little or not at all hæmostatic, but, on the contrary, destined to excite the languid or perverted circulation and old, atrophic, or indurated forms of chronic metritis by a strong appeal to the intra-uterine circulation—the remedy, *par excellence*, for indurated chronic metritis, whether complicated with amenorrhœa or dysmenorrhœa; and it may be used with equal success in other inflammatory processes in which hæmorrhage does not predominate. The positive pole, acid, decongesting, hæmostatic in the highest degree, is especially useful in the hæmorrhagic, congestive, or ulcerative forms; it combats and prevents the tendency to excessive vascularization, and by the same process becomes an indirect treatment for rebellious leucorrhœa."

In the treatment of fibroid tumors even stronger currents are to be used than in the treatment of chronic metritis, and the same form of external electrode employed to enable the localization at the active pole of these strong currents. Intensities as high as 250 and 300 milliampères are frequently used, and on one occasion at my clinic at the New York Post-Graduate Medical School and Hospital, abandoning the external electrode and introducing two needles connected with either pole, directly through the abdominal walls into the tumor, I applied for five minutes a current of 400 milliampères without ill effect. Both electro-puncture and intra-uterine applications are successful in reducing the size of fibroids.

When the tumor is intramural, intra-uterine applications are undoubtedly to be preferred to electro-puncture, but there are many cases where the fibroid is so situated that applications to the cavity of the uterus would have comparatively little effect, and the indications are

for puncture. Deep puncture through the vaginal walls into the tumor is now considered by no means so necessary as formerly. The introduction of the uninsulated portion to the depth of a third of an inch only has, in my experience, answered every purpose, and is far less likely to be followed by bad results than deeper penetration.

For the absorption of pelvic exudations following cellulitis the galvanic current is invaluable. This treatment, persistently used, will dissipate pelvic deposits, and relieve severe sciatic pains due to the pressure of these exudations.

Stenosis of the cervical canal has been much relieved by galvanic treatment through the use of currents ranging from 40 to 75 milliampères. Using the negative pole, there seems to be little danger of any evil result, and the pain is quite slight.

Electricity in Obstetrics.

The use of electricity in midwifery is no new thing. As far back as the beginning of the present century it was recommended to hasten the expulsion of the fœtus, but it was not until a much later date that its use for this purpose excited any attention. "The indication for the use of electricity in midwifery is declared to be an adynamic condition of the uterus where other conditions are favorable for or necessitate immediate delivery."

There are many advocates of faradization in the last stages of delivery; and even in the first stage, when the labor has fairly begun, faradization of the lumbar region will sometimes hasten dilatation of the neck and excite the vigor of the uterine contractions. The current seems to have no ill effect on the fœtus, and indeed it is probable that but a small fraction of the current ever reaches the interior of the uterus.

There are very positive differences of opinion in regard to the value or necessity of faradization in hastening a confinement, but there should be no differences of opinion in regard to the use of the current in cases of post-partum hæmorrhage. The old method of introducing one electrode of an induction apparatus into the uterus and applying the other over the abdomen was in many cases efficient, and has undoubtedly saved many lives by the promptness with which it induced uterine contractions. The efficiency and promptness, however, of this method are not nearly so great as the bi-polar method, where both poles are introduced into the uterus and the induced current of quantity employed. In the treatment of post-partum hæmorrhage it is of the greatest importance that the wide difference between the action of the currents of quantity and tension on the uterine tissues be thoroughly appreciated. The current of tension when applied externally produces most vigorous muscular contractions, but when applied internally its effects are modi-

fied in a most remarkable degree. If the uni-polar method is used, the external electrode will still produce strong contractions, while the internal electrode is hardly felt. Using the same current with both poles applied internally, the contractions that are produced are comparatively slight and inefficient, and in a dilated and inert condition of the uterus it is entirely probable that it would exert not the slightest effect. The current of quantity, however, which when applied externally possesses but little appreciable effect, acts with extraordinary vigor when applied internally to the uterus or vagina. One who is accustomed only to external applications, or who has given no attention to this most interesting electro-physiological and therapeutical phenomenon, would very naturally, if suddenly called upon to treat a case of post-partum hæmorrhage, use the current of tension, which ordinary experience has shown to be so much stronger than the other. In doing this, however, he would be likely, if there existed a marked adynamic condition of the uterus, to utterly fail in inducing any adequate muscular contractions, and fatal hæmorrhage ensue with a remedy at hand capable of successfully combating it.

Electricity has occasionally been successfully used to increase a deficient lacteal secretion. Both the galvanic and faradic currents have been used with apparent effect, but the faradic current, on account of its greater mechanical effect, is perhaps to be preferred. In using electricity, however, for this purpose it should be borne in mind that overstimulation may do positive harm in dissipating the slight secretion of milk that may still be present.

The latest and one of the most important uses of electricity is in extra-uterine pregnancy. If this condition was a common one, it is safe to say that no therapeutic procedure of our time would exceed it in importance and general interest.

While there exists much diversity of opinion as to the value of the method in this condition, some even going so far as to condemn it *in toto*, the very important and suggestive fact should not be forgotten that those who thus condemn it are, as a rule, of the number who have had no adequate personal experience in the matter. From the standpoint of the writer, who has personally treated by electricity as many if not more cases of ectopic gestation than any other, the method clearly seems to be the best, and the only one that should be attempted in the earlier stages.

As early as 1872 electricity was successfully used in these cases for the destruction of the fœtal life, but it was not until 1878 that the details of the method excited any general interest in the profession or incited others to make similar attempts. In that year a case occurred in the practice of Dr. Charles McBurney of New York, and in a consultation with Drs. T. Gaillard Thomas and T. Addis Emmet, Dr.

Thomas suggested the possibility of the use of electricity instead of the knife. When questioned as to the possibility of the operation, I replied that the destruction of the fœtal life was an easy matter, and that it could probably be readily accomplished without special pain or injury to the mother. The results of the attempt, immediately made, fully justified this prediction, and there soon followed many reports of similar cases equally satisfactory. The operation is simplicity itself: One electrode is applied internally, pressed as closely as possible against the fœtal mass, while the other is applied on the abdomen immediately over it. Both currents have been successfully used. If the faradic current is attempted, either pole may be used internally, although the negative is to be preferred. The negative pole is also to be preferred in the use of the galvanic current for this purpose, and is the current which in my opinion performs the work required of it with the greatest certainty and efficiency. An interrupted rather than a continuous current is to be employed, although there may be an advantage in its rapid increase by means of a rheostat. In this way the chemical and physiological effects can be greatly increased, without the disagreeable effects, and even the danger, that might accompany an interruption of the same strength of current. In cases that are somewhat far advanced the danger to be apprehended from an injudicious application of the faradic or the interrupted galvanic current is the possibility of rupturing the over-distended tube. In one case, where the pregnancy had advanced nearly to the fourth month, the necessity for caution forcibly presented itself to me. By gradually increasing and as gradually decreasing the strength of the current I was enabled without fear to make use of a much stronger current than if interruptions had been made, and in this way succeeded in destroying the fœtal life. In regard to the position of the poles, my custom has been to place the positive pole externally. This should consist of a broad, flat sponge pressed firmly on the skin and directly over that portion of the tube where the fœtus is developing. The negative pole is used internally, and may be carried up to the fœtal mass through either the vagina or rectum, according to the position and size of the tumor. In fifteen cases that I have recorded the operation was performed through the vagina in twelve and the rectum in three.

As there seems to be no way of determining positively whether the fœtal life is immediately destroyed by the first application, it has been my custom to repeat it three or four times; and as but little pain is caused, there can be no objection to its repetition on this score. All medical and surgical procedures, however, that are not absoluetly necessary are objectionable, and a remote possibility even of an accident of the kind to which reference has been made—viz. rupture of the tube—suggests that these applications be made no more frequently than will

suffice to accomplish our object. It is proper to say, therefore, that a strength of current just sufficient to destroy the fœtal life is, in all probability, capable of doing it at once, and that all subsequent efforts serve only the purpose of hastening the process of absorption. Applications that are made for this purpose alone cannot be at all objectionable, as the uninterrupted galvanic current is the form indicated. Even to this day there are many who suppose that the operation is purely electrolytic, necessitating the introduction of a needle into the fœtal nest. Happily, such is not the case, for any such procedure might itself be attended with danger, and certainly with considerable pain. The negative electrode consists of a metal ball, and is applied *to* and not *into* the tumor.

Electrolysis.

Electrolysis is more especially a surgical procedure, and, strictly speaking, perhaps has no place in a work of this character. Every passage of a galvanic current, however, through any compound substance is undoubtedly accompanied by some chemical or electrolytic change, although manifestly very slight in degree.

When the electrodes of a galvanic battery are immersed in water and the circuit closed, a more or less abundant evolution of gas takes place. Oxygen appears at the positive pole or anode, and hydrogen at the negative pole or cathode, and the water is separated into its constituent elements. This is termed "electrolysis," the act of decomposing a compound substance by electricity. If a salt solution is subjected to the action of the current, the process is similar, but more complex, the acid being set free at the positive and the alkali at the negative pole. The accepted theory of electrolysis is in harmony with the statement just made, that the passage of a current through the body is associated in every part of its course with more or less chemical action. In every compound one of the elements is electro-positive and the other electro-negative. Under the influence of the opposing electricities from the electrodes decompositions and recompositions go on from one pole to the other. But these decompositions and recompositions are seen only at the electrodes. Water is composed of one atom of oxygen and two atoms of hydrogen. Oxygen is electro-negative, and hydrogen is electro-positive. When, now, the electrodes are dipped in water, the electro-negative oxygen of a molecule of water is attracted to the positive pole, and the electro-positive hydrogen is repelled. The oxygen is then given off at the positive pole, while the liberated hydrogen unites itself with the next atom of oxygen, and the original atom of hydrogen is expelled. This atom of hydrogen unites with the oxygen of the next molecule, drives out the hydrogen with which that alone has been previously combined, and so on through the whole series of molecules until the negative pole is reached. Here the

hydrogen has no more oxygen to combine with it and is liberated as gas. Thus, while the decomposed elements appear only at the electrodes, the intermediate regions presenting no change, it is necessarily traversed by the decompositions that occur.

There is no evidence that organization as such seriously modifies electro-chemical decomposition. The fluids of the body decompose under the influence of the current, just as the same combination of fluids with tissue would decompose if not endowed with life. The great difference, however, in the effects of electrolysis on organic and inorganic substances is seen after the current has ceased to act. In the electrolysis of most inorganic substances—such, for example, as iodide of potassium, acetate of lead, chloride of sodium, etc.—the effects cease as soon as the current ceases; the substances remain in the condition that the current left them. The electrolysis of organic substances starts a process that continues long after the current ceases to flow.

It is to this secondary effect of the current that we must ascribe the gradual but complete disappearance of some small tumors following one or more electrolytic operations. A young woman aged twenty-two came to me some years ago with a goitre of considerable size that had been developing since the age of sixteen years. Electrolysis was used only four times in this case, and at intervals of a week. An appreciable reduction of size was evident, after which the patient came no more. The tumor, however, continued to decrease, and when I saw her, a year subsequently, had entirely disappeared. Such results are rare, but it is not very unusual to witness some further reduction of goitres, and even fibroids, after the cessation of treatment.

Nothing can be more satisfactory than the readiness with which erectile tumors are cured by the introduction of one or more insulated needles and a judicious management of the chemical or electrolytic action of the current.

Reference is not made here to the widespread dilatation of cutaneous vessels, attended with little swelling, commonly called mother's mark, but rather to the subcutaneous variety called aneurism by anastomosis, which may be either venous or arterial. The great advantage possessed by electrolysis is that it cures, provided that the conditions of success be skilfully observed, without hæmorrhage and with little or no scar. When the tumors are situated on parts hidden by the clothing this is not always considered of such great consequence, but when situated on the face, as is so often the case, it is of vital importance. The needles must have a perfect insulation up to within a distance from the point varying from a few lines to a quarter of an inch, so that the skin may be thoroughly protected.

We must do just enough, without doing too much. If the current is too strong or the application too prolonged, the destruction may be

greater than is required, followed by a discharge of pus; and this may result in cicatrization. If the current is too weak and the treatment too short, the tumor may re-establish itself, necessitating a repetition of the operation. It is not claimed that all nævi can be cured without a scar, but many can be; and in the large ones, where the chemical effects of the current extend to the skin, the patient, if a child, rapidly outgrows them. Both poles may be used, connected with the needles, but my experience in a large number of cases is in favor of only one pole in the tumor, the other being applied externally on some indifferent point by means of a sponge electrode. The needle should by preference be connected with the positive pole, since the coagulation at this pole is more rapid and firmer than at the other. If the tumor is small one needle may be sufficient, but if large, needles may be connected with both poles.

THE REST-CURE FOR NEURASTHENIA AND HYSTERIA.

By JOHN K. MITCHELL, M. D.

The system of treatment for the varying conditions of neurasthenia, hysteria, and certain nervous troubles by Rest, including in this term all those developments in the direction of passive exercise, full feeding, and isolation, which I shall have to consider in this article, was first publicly described by Dr. S. Weir Mitchell in a lecture published in 1875 in vol. i. of Seguin's series of *American Clinical Lectures*. In 1877, Dr. Mitchell published a more elaborate description of it in an essay entitled *Fat and Blood*, of which the fifth edition was issued in 1888. Dr. William Playfair of London has used the method and written upon it in England.[1] The present article may be considered as an authoritative statement of the most recent views of Dr. S. Weir Mitchell, and of the latest developments in this method of treatment.

A few words, first, upon the state which we describe by the vague names of "neurasthenia" and "hysteria."

The terms "neurasthenia" and "nervous prostration" are drag-nets that gather up a motley multitude of ill-defined cases which it would be difficult briefly to define. Neurasthenia is a condition made up of subjective symptoms, yet no one symptom is constantly present in all cases. Nervous exhaustion is a phrase used as equivalent to neurasthenia, but excitation of the nervous system is frequently added to the weakness. Usually we find the nervous system both feeble and irritable, and wherever the manifestations appear, whether they be in the circulation, in the gastro-intestinal tract, or in the cerebro-spinal centres, these characteristics of feebleness and irritability are shown.

Certain cardinal symptoms are tolerably constant, however varied the lesser signs may be, which Charcot calls the "neurasthenic stigmata." These are insomnia, headache, enfeeblement of motor-power, dyspepsia, backache (especially in women), and usually brain-fag in some degree. Some of these symptoms are among the earliest signs which the patient observes. To illustrate them very briefly: the *insomnia* is of many kinds and degrees, from mere restlessness and broken sleep to almost total loss of the power to sleep, lasting for weeks

[1] *The Systematic Treatment of Nerve-Prostration and Hysteria*, London, 1883.

or months. This is one of the symptoms which result in endless evil, owing to the hypnotics and narcotics given in the attempt to overcome it.

The *headache* is often rather a distress than a pain, and is very constantly present in neurasthenic patients. Its common seats are the frontal, occipital, or nuchal regions, but it may be anywhere in the head, and varies from a heaviness or fulness to an agony. It is made worse by mental effort, sometimes by movement, and it may be accompanied with vertigo or with subjective aural or visual disturbances.

Of all the symptoms which neurasthenia presents, the most constant is *loss of motor-power*, an utter incapability of sustained muscular effort. It is absent only in the rare cases which may be described as simple brain-fag. Even the smallest effort is a severe exertion, and results in fatigue out of all proportion to the power put forth, or is followed by vomiting or nausea or diarrhœa. Examination will reveal no paralysis, and the reflexes will be unaltered or slightly exaggerated.

The *cerebral fatigue* or depression is of the same kind as the muscular prostration. To attempt to fix the attention, even to observe an action or a picture carefully, to talk even of trivial things, results in unusual fatigue of mind and makes the headache worse. The will, the judgment, the moral control, are weakened or in some bad cases perverted, so that a man of a pleasant temperament becomes aggressive, contradictory, and irritable.

Gastro-intestinal indigestion is often thought to be the cause of the neurasthenia. It is certainly very constantly an accompaniment of it, but in many cases it is rather a result of the general depression than a cause. When it exists the most common complaint is loss of appetite, together with an epigastric weight and fulness after eating, followed by eructations of gas, and there is generally troublesome constipation.

Backache, especially in the region of the sacrum, is frequent, and in women the subjects of neurasthenia it is almost invariably present.

Besides these cardinal points, innumerable lesser symptoms add to or complicate the diagnosis, and neurasthenia is associated with, and runs into, hysterical conditions, so that no one can draw an absolute line between them. A tender spine, anæmia, ovarian neuralgia, wandering pains about the body, a rapid and irritable heart, troubles of sight and hearing,—all may play their parts in adding to the difficulties of treatment. When to these emotional manifestations or to some of them are added contractures, paraplegias, or disturbances of sensibility, we call the patient hysterical, even though she has no disease of the womb or ovaries.

Having very briefly mentioned the symptoms, we have to consider the varieties of neurasthenic troubles which are proper for submission

to treatment by rest. Not all cases of neurasthenia or hysteria are suitable for it. While we have other means at our disposal, it would be most unwise to order, without discrimination, all "nervous" patients into bed—to force upon them a life which involves separation from their friends, the entire attention of one or more attendants, and consequent great expense. It is only when other ways have failed to cure that we should use the rest-treatment. Further than this, many persons are individually unsuited for it. If the nervous prostration be complicated with melancholia, the rest-cure almost never does good. The habit of too minute analysis of their own symptoms, of microscopic investigation of their moral and mental condition, to which sufferers from melancholia are prone, is only fostered by the opportunities offered by confinement in bed and consequent inaction. If to melancholia a suicidal mania be added, it is especially undesirable. The depression increases, the loss of appetite usually becomes greater, and the case grows worse, not better. For such cases active exercise is preferable to the passive movements of massage, and open air and movement are better tonics than those of the apothecary.

Acute uterine or peri-uterine disease, while it lasts, contraindicates the rest-treatment. The forms of chronic ovarian disease, for which Battey's operation is usually the only recourse, improve, but seldom recover, though they may improve sufficiently to make surgical interference both easier and more successful. Without such interference they are rarely cured. Advanced Bright's disease or advanced phthisis forbids the use of such a course, but the earlier stages of these diseases may be successfully treated in this way. The cases which do best are bed-ridden hysterical patients suffering from that extraordinary variety of symptoms which make the hysterical panorama—wasted, without appetite, with localized anæsthesias or contractures, morbidly dependent upon sympathy, at once the despair and the livelihood of many physicians. The worse these cases are, the more emaciated, the more hysterical, the more hopeless in appearance, the easier is the cure as a general rule.

The most important indication in favor of this course is found in the patients who have, together with the severer forms of neurasthenia or hysteria, that moral degeneration which is present with them so frequently, and those to whom a too anxious family offer overwhelming attention and sympathy.

In treatment a distinction must be made between the two varieties of neurasthenia to which the French have given the names of "myelasthenia" and "cerebrasthenia." In the latter a man who is prostrated by too much intellectual work or strain, and yet is not physically exhausted, should be treated by having his activity, mental and bodily, measured for him in definite doses. In the former, in which the spinal

or medullary centres are in trouble, isolation and rest must be practised. Great anæmia and its congeners, chlorosis and leukæmia, are well treated in this way.

It is hardly necessary to say that a large proportion of neurasthenic patients are women. Indeed, as a rule, rest-treatment is not a means which acts well with men, although there are exceptions. The reasons for this fact are not far to seek. Men are more accustomed to activity. They are less amenable to the necessary discipline, they are more impatient of small restrictions and of slow progress. They seldom get so far advanced in hysterical disease as women, and simulated disease is rare among them. Change is easier to women. They are more accustomed to go up and down physically. A woman loses weight every month with her menstrual flow, and to gain and lose flesh is physiological with the female sex, as it is not with the male. Every physician who has had much hospital experience has noted how much less women are affected by loss of blood than men. Even in hæmorrhages from wounds this is true, and how constantly we see menorrhagia followed by extraordinarily rapid recovery! In a few days the patient will have returned to a nearly normal state, whereas were a man to lose a like amount of blood we should have to help him through a long course of iron and tonics before he could recover; and these tendencies repeat themselves both as to disease and as to therapeutics. Dr. Kleen, in the excellent book on massage which he has recently published,[1] does not find this difficulty, but his patients appear to have been mostly of German origin, and perhaps racial differences may account for the ease with which he succeeded in keeping men in bed for six weeks.

Other important indications for this treatment are found in those conspicuous defects of nutrition which evidently unfit an individual for the use of the muscles. In a person in whom a trifling over-exertion results in a great emotional display no improvement will take place until the nutrition is improved. Harm will be done by making such a person drag himself about, and a more complete breakdown will be the result. Fortunately, rest is a medicine from which little harm can come, so that when we are in doubt we may be sure that we are at least on the safe side by prescribing it.

One danger, it is said, of putting a patient to rest in bed is that we may not be able to make her get out of bed again when the proper time has come; but this does not seem a very serious danger; at least, it is one which the writer has never experienced.

The most important element of all is one which is of weight in any treatment of every disease—the personal element. One physician succeeds where another, equally as able, fails. Important as the question

[1] *Handbuch der Massage*, Dr. Emil Kleen, Berlin, 1890.

of the physician's share in the case may be, it is hardly possible to discuss it here, but it is well to remember that faith is a good adjuvant to even the most active drugs, and faith in the doctor the patient must have, especially in a treatment in which the progress is often so slow and the gain from time to time so little apparent.

The usual beginning of the cases needing rest-treatment is in some exhausting physical or mental strain. Sometimes an illness from which the patient has never entirely convalesced is the starting-point, or a local uterine or ovarian trouble. The patient presently grows pallid, wastes, loses appetite, or, if she eats, her food seems to do her no good. The smallest exertion is followed by disproportionate fatigue. The effort of keeping up social relations leaves her daily more and more exhausted. She begins to sleep badly, has indigestion, is constipated, and is incessantly becoming feebler. If she is of an emotional nature, this tendency becomes more and more dominant until her emotions rule her. Even if she were previously not emotional, she presently becomes so. "The moral degradation which such cases undergo is pitiable. The result is to cultivate self-love and selfishness, and to take away by slow degrees the healthful mastery which all human beings should retain over their own emotions and wants." A physical examination of such a case will perhaps disclose no organic changes. A trifling exertion excites the heart unduly. If there is great anæmia, a hæmic murmur may be heard over the heart at the base. A tender spine, tender ovaries, and asthenopia are often found, but further than this we can observe little wrong. An examination of the blood reveals the ordinary features of the different grades of anæmia—diminished hæmoglobin and a lessened number of corpuscles —but for the host of aches and pains of which the patient will speak no adequate physical causes can be found.

What shall we do with such a case? The sufferer has run the gauntlet of tonics, has been stimulated with alcohol, has been depressed, and had her digestion upset with bromides and perhaps with opium; she has tried without success to secure sleep by chloral or other hypnotics; she has been through water-cures and sanitariums; she has tried Christian science and skepticism.

An endeavor will be made in these pages to describe the method of handling such cases, so that a physician with no previous experience of it may discover how to apply this treatment to the bettering of this melancholy array of symptoms. The means to be used consist of isolation, rest in bed, passive exercise, certain forms of diet, and electricity. How far these means should be modified in different cases will be pointed out under each head. It may be said that during cold weather is the best time for applying this treatment, but hot weather,

unless there is excessive heat, need not forbid it. Women should begin treatment immediately after a menstrual period.

Isolation.—The first point to be considered in detail is that of seclusion. No other single feature is of such importance; to no other is it so difficult to secure consent. Even when the patient is willing, the family sometimes are not. It is easier to seclude a patient away from home, but if any success is to attend upon the application of this treatment, somehow the patient must be separated from friends and relatives. Naturally, in a patient's own house this is not easy. It seems hard to a mother or sister that she must be kept upon the far side of the door from the invalid, and not allowed to see her for five minutes; but in neurasthenic and hysterical patients the sympathy which they extract from those who surround them is a food which nourishes their disease. Then, too, this isolation is useful from the total change of moral atmosphere, and from the fact that as the patient grows better she is more and more anxious to escape from the enforced seclusion, and adds her own efforts to those of the physician and attendants.

Cases of myelasthenia, of purely physical prostration from overwork, from hæmorrhage, or from nervous breakdown where there is no hysterical element, may be handled in their own homes, and need not be so entirely separated from their friends. But the neurasthenic, the hysterical, the morbidly fanciful patient, or the one with simulated disease should be rigorously separated from all her acquaintances, away from her family, receiving no letters and sending none. There is another reason why this seclusion is useful. By it one is enabled to gauge the amount of the emotional element in the case—to see how far it is due to the patient's own disposition, and how far it arises from or is increased by her surroundings. If the disease is simulated, she will soon find the audience too limited for the successful production of dramatic effect.

As to the place in which to treat the patient, the best one of all is either a well-managed boarding-house devoted to such uses or a good private hospital. Such cases do not do well in a hospital ward, and even in private rooms in a general hospital it is for many reasons rare to meet with success. If a patient is placed in a private room of a general hospital, it is well to direct that the resident physician shall make but one visit daily, in order that she may not have this addition to her audience.

For any person absolutely at rest in bed a nurse is needed. In a hospital one attendant can care for five or six persons, as she is always within call, but in a private house it is best to have a nurse devoted entirely to each patient. Besides this attendant the patient will see only the doctor and the person who does the rubbing which is necessary.

Too much consideration cannot be given to the selection of a nurse. Now and then these cases can be carried through with the aid of an unusually firm and intelligent relative as a care-taker, but the nurse should be a stranger to her patient if this is possible; and should the patient come into the physician's hands with a nurse accompanying her, it is usually best to discharge this nurse.

One of the first qualifications of a good nurse is youth. Even experienced and scrupulously painstaking attendants lose, as they grow older in their business, that enthusiasm which is the prerogative of youth, and unless they are unusually conscientious this lack is not well replaced by increased experience. But youth, of course, is a relative term, and there are occasional nurses who seem never to grow old in this way. Quite beyond the qualities useful in a nurse for ordinary acute cases, a woman who is to have to do with hysterical patients must have keen observation, tact, discretion, intelligence, and a certain delicacy of feeling and of manner, or else the sensitive nerves of the patient will certainly revolt. She must be observing, for much of the physician's knowledge of the case and its peculiarities will depend upon her report. She must have discretion enough to know when to tighten and when to relax the reins of discipline—when to yield without giving up, and when absolutely to refuse to bend to the numberless fancies of her patient. Over-harshness will perhaps produce worse effects than too easy yielding. The nurse must remember that in enforcing discipline she should never come to an open fight with the patient; if she does, it has to be reported to the physician, and the nurse is put in the position of a spy and an enemy by it. Let her drop upon the doctor's shoulders the responsibility of an annoying decision. It is better that the patient should think that the doctor is the author of the disagreeable necessary discipline and the strict enforcer of the letter of the law, than the nurse, whom she should learn to regard as her best friend.

The nurse should make it a rule to follow the physician out of the room for a discussion of orders, symptoms, and questions of management. Neither these nor therapeutic matters should ever be talked over before the patient. If this going out is a matter of daily routine, the patient will not be suspicious of it, whereas if it be done but once in a great while she will be sure to fancy that it means complaint or tale-bearing or the gossip of the sick-room. On the other hand, it is well to talk with the patient freely about the nurse, and to consider her opinion, for, after all, she is the person most interested, and to have a daily talk with her without the restraining presence of the nurse. If the case does not do well, and it is not possible to find a clear reason for it, if the food seems to be well assimilated, the functions to be properly performed, and yet the patient does not advance, the attendant should be

changed. There should be no hesitation in removing the nurse if she and the patient do not seem to get along well together. Even the best nurses will not agree with every patient, and the writer has recently had occasion to provide three nurses in as many weeks for one lady, although at the same time he was not able to find fault with any of the nurses. Still, we are too apt always to fancy that these difficulties are the patient's fault; often enough they are really the nurse's, for it is a necessary part of the nurse's business to be able to get along well with nagging or fretting patients.

Some other minor qualities must be looked for also in the nurse with whom a patient is to be in close confinement for two or three months. She should be able to read aloud well, and to write a good letter, and she must have intelligence enough to perceive how to interest her patient in little things as she grows better, and to keep her sufficiently occupied to lessen the monotony of the sick-room.

As to the difficulties which follow isolation, they are fewer than at first seem likely. Occasionally patients when first separated from their usual surroundings have an access of emotional symptoms or crises which may last for several days. Only time is needed to relieve this. As to the duration of the isolation, it is hard to make a rule. In milder cases six or eight weeks of it will be enough to produce the effect desired, and the patient may afterward gradually return to her ordinary avocations in society; but the more grave hysterical cases it is sometimes necessary to keep isolated for many months, and inveterate hysterical performers will relapse when seemingly well if the cure is not well established and, as it were, clinched by a careful and methodical life without excitement for months after the cessation of active treatment. The medical attendant must be the judge of how long this seclusion should last. Toward the end letters are allowed to be received limited in number, and later permission is given to write briefly once or twice weekly to her family. Isolation is not a matter of weeks and months, but of results. The results which we desire to obtain are to separate the patient from the habits of long illness, from the too tender solicitude of her family or friends, to restore the enfeebled will-power and strengthen the morale, and make the invalid once more able to bear her part in every-day life.

Rest.—The second point of the method is rest. This too, like the isolation, is often badly borne during the first few days, but it is astonishing after a time to see how an active and stirring woman will settle down to a life of absolute immobility, and find it not only not disagreeable, but much to her taste.

Rest in these cases is a relative term, and varies from merely lying down for a few hours during the day to entire inaction in bed, carried even to the extent of forbidding the patient to feed herself or to turn

herself over. Such strict measures are only necessary in those grave cases in which there is great exhaustion alike of the cerebral and spinal centres. In them no more than the necessary interchange of speech should be permitted. At first, in very serious cases, food is taken better and in larger quantities if the nurse feed the patient than if the patient use her own hands to serve herself. It is, however, seldom necessary to carry the prescription of rest to so extreme a point as this. Ordinarily, the patient is allowed to feed herself while lying upon her back, being only allowed to sit up for the carrying out of her natural functions. In this way no demands are made upon the overstrained nervous centres. The voluntary muscles are not used, the mind is kept as inactive as possible, and the circulation is lowered, to the great easing of the nervous palpitation from which so many cases suffer.

The disadvantages of rest are that it lessens the appetite, that it increases the constipation, which nearly always exists in hysterical and neurasthenic people, and lowers the power of assimilation. These inconveniences we endeavor to remedy by passive exercise, as will be described later on.

When decided improvement begins to be visible in a patient's general state the rest becomes less absolute. A beginning is made by allowing the patient to sit up in bed at meal-time; then for ten minutes twice a day in a chair while her bed is being put in order. This is usually not permitted before the middle of the second month: probably four weeks is the *least* period of rest which is likely to produce favorable results. This sitting up is gradually increased by periods of five or ten minutes daily until the patient is sitting up about an hour twice a day. She then begins to take a few steps, and in favorable cases the exercise is rapidly increased, until at the end of perhaps ten days from her first efforts at walking she is sent for a drive, walking being at the same time kept up and daily increased until a reasonable amount of active exercise is taken. The patient is not permitted to make the unnecessary exertion of going up and down stairs at first, but is carried in a chair to and from her room and her carriage. Often at this point a difficulty is encountered in those confirmed hysterics who prefer a life of easy invalidism to the burdens which physical well-being and activity impose upon them. They complain that in spite of increased flesh and apparent increase of muscular ability exertion causes pain in the spine, headache, indigestion, and fatigue. But if it is certain that they are well nourished, they should be remorselessly driven by the nurse and the doctor to taking the prescribed daily exercise, and told that the more they disregard the symptoms which result from exertion the less trouble they will give. If they have that necessary faith of which we have previously

spoken, they will soon learn the truth of this. Perhaps this is cure by suggestion, but if it be a cure, what matters the name?

For many months, even after an apparent return to perfect health, it is well to direct a certain amount of daily repose, for an hour after each meal, with no occupation, neither talking nor reading, during this time.

Diet.—Next comes the question of food. The patient before beginning her rest should be weighed, that there may be some absolute criterion of the gain made. Dr. S. Weir Mitchell does not, so constantly as he formerly did, begin with an absolute milk diet, finding that many patients do well on a modified diet *plus* milk. But when digestion is impaired or there is gastro-intestinal atony like the asthenia which affects the nerves and muscles, when entire loss of appetite is present, or that hysterical anorexia to which all foods are loathsome, and the patient is in a fair way to become a starving phenomenon, milk diet is the best starting-point. Every day one sees patients struck with horror at the idea of being fed on milk alone or milk at all. They say that milk from their earliest days has disagreed with them; that it upsets the stomach; that it constipates the bowels; that it causes endless strange difficulties. In spite of these assertions, it is rare to find a person who cannot really take milk when it is insisted upon. Sometimes it is necessary to begin with what seem absurdly small amounts—a tablespoonful of skimmed milk four or five times a day, increasing the dose, and gradually increasing the amount of milk while decreasing the other food. Four or five days of milk to start with, even in those cases in which no long continuance of this diet is intended, clears the way for other dietetic or therapeutic measures. In any case only skimmed milk should be used, and it should be fresh and in good order. If no difficulty in taking milk is experienced a quantity of about four ounces may be given every two hours, warm or cold as suits the patient, increasing to eight or ten ounces every two hours. In those to whom the taste after a time grows unpleasant caramel may be added, or chocolate, or a spoonful of coffee or tea, as a flavoring. Some persons do better with barley-water or rice-water added to the milk, and some with lime-water, but in much the largest proportion of persons carefully skimmed milk without any addition is sufficient. In the occasional cases which cannot take milk in any other form it may be given *partially* peptonized with Fairchild's extract of pancreas; and if this is carried to a very limited degree or the peptonizing agent is only added to the milk as it is handed to the patient, the disagreeable bitterness which results from completely peptonizing is avoided; or koumyss may be given, or Nestlé's Food substituted for a portion of the milk, or used alone if the prejudice against milk is inexorable. Milk frothed with Vichy or ordinary carbonated water is sometimes liked and easily taken. A cup

of black coffee in the morning when awaking is sometimes well borne, and frequently without further medicine will keep the bowels in order.

Dr. Kleen contends that milk, though it serves well for children, is not a complete or ideal food for adults, but this is a contention it is difficult to support. It is a complete food if given in sufficient quantity. One case has come under the writer's observation in which a gentleman with advanced diabetes and beginning nephritis lived in comparative comfort, carried on large business interests, and led an active existence for seven years on milk alone. The ease with which it is measured as a food is a great advantage. It lessens irritation in all organs; it makes the patient sleepy; even alone it seems a competent means of fighting hysteria. In nephritis and in diabetes nothing has been found to equal this diet; in stone in the bladder the frequent urination is relieved by a milk diet, and so marked is the result that Paget has suggested that before lithotomy the patient should be fed for some days on milk alone.

If the milk is used at first, after four or five days the patient receives a single chop at mid-day; the next day a piece of toast or bread-and-butter at supper. These two meals are increased slowly for a day or two, then breakfast is added, and when by small advances the patient has arrived at taking three full meals and two quarts or thereabouts of milk a day, it may be advisable to substitute for a portion of the milk some other food, such as Nestlé's or one of the several peptone preparations,[1] or some of the peptonized foods, the recipes for which are to be found in the books published by the makers of the peptonizing powders.[2]

Massage.—Massage is a matter about which much mystery is made and a good deal of nonsense talked. Some people regard it as a mysterious or miraculous process, like the "laying-on of hands" of the "natural healer," which produces great results in some strange way that we cannot comprehend.

Many different systems are in use, but the really essential parts of the ordinary practice of general massage may be written down in a couple of pages, though of course it cannot be *taught* in that space, for much practice, with careful watching of the progress of the pupil, is necessary to a reasonable perfection in the art. But, given to begin with a certain natural aptitude in the use of the hands, any ordinarily intelligent person who is strong enough can learn it.

[1] Most of the "peptones," "peptonoids," "beef-peptones," and so on, as commercially offered, are either of an extremely disagreeable odor or a very sweet taste which is obnoxious to sensitive palates. This latter trouble arises from their preservation by glycerin, which is often in such excess as to act as a purgative. There are, however, two or three excellent preparations, and especial mention may be made of the French "wines of peptone," which have given very good results as tonics and nutriments in the writer's hands.

[2] For dietetic tables see Dr. Yeo's article, p. 691.

For the less severe cases sometimes the nurse may be the rubber, but in the more seriously ill the nurse is so much occupied with other things that to ask her to rub the patient becomes a somewhat severe tax physically. If the physician have no previous knowledge of the qualifications of the masseuse, it is well to see the first treatment or two, lest it should be wrongly done. The ordinary professional rubber has a number of fixed ideas of her own from which it is difficult to wean her, nor does she usually care to learn afresh, in order to meet the views of the physician, a business in which she considers herself quite perfect.[1]

Systematic massage should begin within the first forty-eight hours after the patient is put to bed, and be continued daily for a length of time which will vary with the progress and requirements of the case. It should begin with gentle stroking of the whole body for from fifteen to twenty minutes, for two or three days, then going on to thorough deep massage of the entire surface of the body and limbs, exclusive of the head and neck, and be rapidly increased in duration to an hour or an hour and a half daily. It is rare to find patients who do not, after the first few treatments, bear it well. Now and then one is seen in whom rubbing is followed by a chill or by exhaustion so extreme as to forbid its repetition. Dr. Playfair has found it useful in many cases to order its administration twice daily; and this may sometimes serve, but care must be taken not to over-exercise the muscles of the patient in this way. Dr. Playfair gives one excellent practical hint. He says that he does not care to see that the massage is being effectually carried out. If after a week's rubbing the patient is not taking easily the amount of food prescribed and perfectly assimilating it, the massage is undoubtedly being badly done. The muscle-waste is not being produced which will admit of so much food being absorbed. The proper test is the patient's power of consuming and digesting food.

Another point may be mentioned: that if weighing shows the patient's weight to be increasing with abnormal rapidity, either the massage is not sufficiently thorough or the diet needs regulating in a different way.

Attention should be paid here and throughout the whole course of the case to the urine, as the appearance in it of a deposit of urates is an indication that assimilation is not perfect, and that the patient is taking an amount of food which it is not possible for the system to utilize.

One of the most important parts of the application is the thorough

[1] For extended information upon the movements and technical processes of massage the reader is referred to the article on "Massage" in this volume by Dr. Benjamin Lee or to Dr. Kleen's book, already mentioned (*Handbuch der Massage*), which is far the best upon the subject that has come under the writer's notice.

rubbing of the abdomen. This is especially desirable in view of the frequency of obstinate constipation, both in hysterical cases and in persons long in bed. For this the patient should lie upon the back with the head and shoulders somewhat raised and with the thighs slightly bent, and be told to breathe freely and not to make tense the muscles of the abdomen. This last is an order which will be found difficult to obey at first, but which soon is readily followed. The rubber, using either the heel of the hand or the three middle fingers together, begins with a firm, deep pressure, one hand following the other with a slight circular movement, and with sufficient pressure upon the skin to prevent its slipping from under the fingers. This motion is begun in the right iliac region, working gradually upward into the gastric and hypochondriac regions, across at the margin of the ribs, and downward again to the symphysis pubis. In this way every square inch of the ascending, transverse, and descending colon is gone over, except those parts which it is anatomically impossible to reach, the right and left flexures.

For action especially upon the stomach the gastric and left hypochondriac regions should be treated in the same way. Of course only a small portion of the normal stomach can be reached, but should the stomach be in a condition of dilatation a good deal of its surface is brought under the touch.

Many of the foreign manipulators use vaseline or cocoanut oil while operating. The consequent lessening of friction lessens the stimulation of the skin and makes more difficult the proper deep kneading, besides having other inconveniences, such as its uncleanliness and its amazing promotion of the growth of hair. It is occasionally needed when rubbing hairy men, to allow the hands to slip over the hairs without pulling them.

The observation of trained rubbers about the condition of the patient's muscles is very useful, and one learns to depend a good deal upon what they say.

Electricity.—Besides massage for exercise, it is desirable, when possible, although the least necessary part of the treatment, to use a slowly interrupted faradic current to the muscles once a day, going all over the body—an operation which is easily and rapidly done if the operator knows Ziemssen's points. It is best that this should be given by a physician, but, as it consumes much time, the expense to the patient is increased, and for ordinary purposes it may be sufficiently well carried out by a nurse or a masseur. The slowly interrupted current produces a slight contraction of each muscle, and is, besides, in some way not fully understood, of distinct tonic value. After the daily faradization of the muscles has been completed in cases in which the spinal centres seem affected, the use of the rapidly interrupted current through the spinal

cord does good, placing one pole on the nape of the neck and a large electrode upon the soles of both feet, or the ordinary electrode first upon one foot and then upon the other, for a few minutes each. This application should last not less than a quarter of an hour. With these two means, electricity and the kneading of the muscles, we get excessive waste of tissue. We supply this again by excessive feeding, which is made possible by the improved assimilation resulting from the promotion of the digestion and of the circulation brought about by the rubbing and the electricity.

As a trifling practical hint concerning the administration of electricity it may be added that, as many patients fear the very name—some from ignorance, some from recollection of the pain inflicted by its use in rough or incompetent hands—it has become a rule with the writer to begin by passing the electrodes over the skin without making any connection of the wires with the battery. Hysterical patients, already fearful of the results of the application, complain of this excessively. They say that they feel it in their spines or in the tops of their heads, or that they cannot sleep afterward for the excitement which it causes; but if it be kept up for a day or two without regard to the complaints, and they do not then become reconciled, they are then told pleasantly (but without making a jest of it at all) that the complaining has been of the effect produced by two moist sponges, and that no current has touched them. In fact, the current which need be used in most cases is very mild and should not produce any pain.

The enormous amount of food which can be taken by a patient properly rubbed and exercised in this way is shown in the astonishing reports in Dr. Mitchell's and Dr. Playfair's books. Five pints of milk and a pint of soup or other fluid with three full meals is not an uncommon dietary.

It has already been said that the secretion of urine must be especially watched, so that no deposit of urates may escape notice. It rarely happens that nausea is experienced during the taking of this excessive quantity of food, but if it should be, or should any symptoms of dyspepsia appear, a return to strict milk diet for a day or two will usually be sufficient to settle the rebellious stomach.

Medicines.—The subject of therapeutics, or rather the administration of medicines, may now be considered. If the patient show any degree of anæmia, iron should be given early and continued throughout the whole period of treatment. Malt extract may be used as an assistant to digestion and a useful appetizer. There are now so many good extracts that it is hardly necessary to particularize any one. The maximum amount to be given is about three ounces at each meal, taken before or with the food. A cheaper substitute is three ounces of good brown stout with a teaspoonful of dry malt added.

For the many patients who have an idea that they cannot take iron, one of the nearly tasteless salts, like the pyrophosphate or the lactate, can be dissolved in the malt, and very large doses taken in this way—five to twenty grains three times a day.

Blaud's pill is generally well borne, though perhaps a little constipating, but not more so than other forms of iron; and as much as twenty-five or thirty grains of this preparation may be given in a day, watching the passages to see that none of the pills come away undissolved, which will not happen if they be fresh and well made.

If the case be under treatment in the winter-time, cod-liver oil, in doses of half an ounce or less, may be given half an hour or three quarters of an hour after each meal. Dr. S. Weir Mitchell suggests that in those patients in whom it causes nausea it may be used by enema, and will thus have the double advantage of causing the bowels to act regularly and of being absorbed as nutriment. After the patient begins to sit up and move about, some one of the combinations of iron, quinine, and strychnine, or iron, quinine, and arsenic, may be used. Occasionally nervous patients are made more nervous, or even (though rarely) sleepless, by the stimulating effect of the strychnine, and this should not be forgotten in observing them when they are taking doses of this drug.

An excellent tonic, sometimes better borne than the syrupy elixir, is a solution of the hypophosphites of iron, quinine, strychnine, and calcium. The ordinary commercial preparations of hypophosphites usually contain an excessive quantity of phosphates, or are either very sweet syrups or solutions of a decidedly acid reaction. Both are objectionable if taken for a long time. A nearly neutral solution is perfectly possible, and any good apothecary should be able with care to make it.

Special Difficulties.—It may be well to speak separately of some of the difficulties which we encounter in the course of treatment, and of the symptoms which call for special notice. At first, in these cases sleeplessness is not uncommon, and there is no objection to an attempt which is very frequently successful to establish a habit of sleep by the use of hypnotics for a few days, should the milk-diet fail to have a sufficient somnifacient effect. Many nervous patients are extraordinarily rebellious to hypnotics, and some have established a tolerance of large quantities by prolonged use, so that experiments must be made with various drugs in varying amounts. Sulfonal, though uncertain, will often answer well, but must be taken an hour or two before the patient is expected to sleep. The most satisfactory way of giving it is either in small repeated doses of five or six grains each every half hour for two hours before the sleeping-time, or the maximum dose of from fifteen to thirty grains dissolved in boiling water and taken as hot as the patient

can easily swallow it. The bitter taste is objectionable if it is taken in this way, but the effect is very prompt.

Most neurasthenic patients have had insomnia as a symptom, and have been through the list of sleep-making drugs, but it is rare for sleeplessness to continue as a troublesome symptom beyond the first few days, so calming is the effect of the regulated life and quiet of the sick-room. Should they sleep restlessly or wake at frequent intervals, a drip sheet may be used at night in the manner recommended by Ziemssen. The patient, stripped naked, is wrapped in a sheet wrung out of water at a temperature of about 90°, then rapidly rolled in a warm, dry blanket, and left lying upon the bed for a few minutes. Ten or twelve minutes is usually sufficient to recover from the first shock of the cold water and to experience an agreeable reaction. The patient should then be thoroughly dried by lively friction with a warm towel, and put into bed wrapped again in a blanket. As the patient improves in strength or becomes accustomed to this application, the temperature of the water may be gradually lowered, but it should never be excessively cold. The action of this measure is not only without danger, but is to most patients agreeable and both tonic and sedative—useful in toning the nervous system and lowering the excitability of the peripheral nerves. This is generally enough to produce sound and refreshing sleep. If it is not, a light surface rubbing with the hand (not kneading the muscles) may be given by the nurse the last thing before bed-time.

Some patients find the employment of faradic electricity to the spine late at night an aid to sleeping, although quite as many think the application of the rapidly interrupted current so exciting as to make them sleepless if it is given in the evening. Some means must be taken to produce sleep if after the first day or two it does not come of itself, for frequently patients will not gain much until you secure a few good nights' rest for them either with a hypnotic or some of the other means described.

Baths, except the sponging in the morning, as described in the schedule, are not of much service in the conditions we are discussing.

Constipation is an almost invariable accompaniment of rest in bed, and a trouble which one always finds it hard to combat in patients not actively exercising. Should it be obstinate, and not readily overcome by massage of the abdomen or by the fruit which is made a part of the regular diet, a pill of aloes and ox-gall with belladonna, repeated two or three times a day if needed, may be given, or from ten to twenty drops of the fluid extract of cascara sagrada added to the malt extract, once, twice, or three times daily. The extract is more generally effective than the more elegant preparations of cascara, and is not only palliative, but curative, as is shown by the possibility of using it in gradually

lessening doses. The rapidly interrupted faradic current used upon the abdomen, with the poles upon both flanks and gradually moved over the surface, but kept well apart, so that the current may penetrate more deeply, is also serviceable.

For very obstinate cases other methods of stimulating and exercising the abdominal organs are needed in addition to the massage of the abdomen in the manner which has been previously detailed. For instance, let the patient lean forward over the padded back of a chair, resting the hands upon the arms of the chair and the lower part of the chest upon its back. The manipulator, standing behind, clasps the belly with both hands and shakes it rapidly up and down and sideways. This reaches all organs, and has the beneficial effect of horse-exercise, but is more severe. The position absolutely relaxes even the most hysterically contracted abdominal muscles. Of course this mode of procedure is not possible until the patient is strong enough to be up and about.

After years of enemata have ruined the muscular tone of the rectum, or in persistent forms of hysterical constipation, electricity, locally applied, is useful. An electrode with an insulated stem carrying a metal cylinder on the end about one and three-quarter inches long and one-third of an inch thick, is inserted into the rectum and an ordinary large flat electrode placed over the abdomen, while a rapidly interrupted faradic current is passed between them for fifteen to twenty minutes daily. The current should be mild, and it should always be tested before applying it. The electrode is moved slowly about, so as to reach all parts of the wall of the rectum, and may be inserted even eight or ten inches. A nurse can do this with a little instruction.

As a preparation for sitting up, Swedish movements are of use, and afterward are of value in order to keep up the necessary amount of exercise; at first they are passive and then active, and, after the patient is moving about, the movements may be resisted. Especially valuable are the resisted rolling in and out and up and down motions of the thigh with the patient seated. These have a great effect upon the pelvic muscles. (For detailed accounts of these movements the article of Dr. Lee must be consulted.)

A point where a physician new to the management of patients undergoing the rest-treatment will encounter difficulty is when the patient is first called upon to rise from the bed on which she has been recumbent for many weeks. She has been gaining flesh, she has grown rosy, lost the tenderness of her spine or ovaries, her pains, her sleeplessness, and her general nervousness. She is sure to think that she ought to be able to rise directly from the couch and return to her ordinary avocations, unless, indeed, she is one of the inveterate hysterical cases which require to be driven, as it were, at the point of the bayonet to exercise and

movement. It is here that the patient's faith in her physician must be absolute, for when she gets up she will find herself scarcely able to take a step, and too often the mistake is made of allowing or urging the convalescent to do too much or to increase too rapidly the duration of her time out of bed. Every one knows how weak a man feels who has been bedfast, even without acute illness, for days or weeks. It is enough for a beginning to allow the patient to sit up in bed for a few minutes twice daily; then in an arm-chair for ten or fifteen minutes in the middle of the morning (of course without an elaborate toilet), and then for the same space of time in the evening while the bed is being made for her final retirement. These two periods may be increased by daily amounts of five minutes each. When she begins to sit up for half an hour twice daily, the electricity is dropped to three times a week, and active Swedish movements substituted for the passive ones which have been already ordered after the massage. When she has done this for a few days and finds the gymnastics not too fatiguing (and this again is a point to be very carefully watched), resisted movements may be begun and gradually substituted entirely for the massage. After ten days of sitting up the electricity may be stopped altogether. Some rubbing, often only superficial, is agreeable and restful to the patient for several weeks longer. The milk between meals also must be diminished, but need not be stopped entirely, and when the patient has returned to her home she is usually told to continue taking between meals five or six glasses of milk daily.

Active Exercise.—Attempts at walking should not begin until the patient is accustomed to sit up for three-quarters of an hour, and it is not until she can walk freely and steadily about the room that she should leave it. If the need of fresh air be felt, let her sit by the open window carefully covered, and, as her strength increases, begin to practise stair-climbing, commencing with two or three steps down and back, and increasing one step every day; or, should she gain strength fast, a little more exercise may be had. She may now go to drive, and presently to walk. Here, again, is a point at which there is often trouble. Many patients have before partly recovered under various plans of treatment, only to find that when they attempted exercise they again relapsed, and they are constantly filled with fear of active exertion. If the patient is really strong, if her food is well taken and absorbed, her adviser should be discreetly merciless. Not uncommonly a chief reason for disliking walking in the street is the presence of a terror of crowds, a common nervous symptom in some cases.

When the convalescent is able to walk a reasonable distance of four or five blocks, and to take a long drive without fatigue, she should go to the seaside or to the country for a change, to stay three weeks or a month, and thus to test herself and her newly-regained self-control

LEEDS & WEST RIDING
MEDICO-CHIRURGICAL SOCIETY

away from the encouraging presence and moral support of the physician. After this, should it be possible, she may go inland or to the mountains, and thus get the benefit of all that different airs and altitudes can do for her. Each move brings a change of diet, of life, and of surroundings, and after a couple of months spent in this way she should be able to return to her home, and, with common sense as to daily diet, to remain well. Even then a useful precaution to take is to continue a certain amount of rest, especially an uninterrupted hour of entire peace after each meal.

Before her final departure assurance should be had by a careful examination of the eyes that any error of refraction is fully corrected, while any uterine displacement which remains should be mechanically treated.

Duration of Treatment.—As to the total duration of a course of rest-treatment, a definite limit is hard to fix, but a promise should be formally required from the patient or her friends that they will make a trial of at least a month, and in any except the lightest cases it is well on the physician's part to make no promises to let the patient go in less than three months. Of course success may be attained in a very much shorter space of time, and with the fortunate cases which do well from the beginning, where the good-will of the patient is enlisted on the doctor's side and her help aids his efforts, six weeks is a medium period. It should scarcely be attempted in less if any lasting good results are to be obtained—four weeks' absolute rest as described, a week to get up, a week to get out—and even this is hurrying matters a little.

An example is appended of the form of schedule which the nurse is given when the patient is to be put upon full "Rest-Treatment:"

Miss A. B——.
Oct. 1st, 1890. Last menses, May, 1889.
Nurse C. D——. Weight, 111½.
Masseuse, E. F——.
Bed 3.

Cocoa at 7 A. M.
Cool sponge bath with rough rub, and toilet for the day.
Breakfast at 8 A. M., with milk.
Rest an hour after.
8 oz. peptonized milk at 10 A. M.
Massage at 11 A. M.
8 oz. milk or soup at 12 M.
Reading aloud by nurse half hour.
Dinner at 1.30 P. M.
Rest an hour.
8 oz. peptonized milk at 3.30.
Electricity at 4 P. M.
Supper at 6.30, with milk.
Rest an hour.
Reading aloud by nurse half an hour, 8 P. M.
Light rubbing by nurse, with drip sheet, at 9 P. M.

3 oz. malt extract with meals; tonic after meals.
8 oz. peptonized milk with biscuit at bed-time, and a glass of milk during the night if desired.
Laxative (cascara), 10–30 drops p. r. n.
Later, Swedish movements are added after the massage.

Melancholia.—Melancholia was spoken of in discussing the indications, as contraindicating the full treatment by rest, and before concluding it may be desirable to speak fully of the sort of treatment to be used for men or women the subjects of this disorder whom it is not advisable to put upon a regimen of absolute rest. The treatment to be described does not require the entire services of a nurse, although in melancholia cases it will be well, when possible, for the patient to be under the care and direction of an attendant. For these persons even more than ordinary care should be exercised in the selection of the nurse, for upon her tact and the strenuousness with which she carries out the minutest details, and the discretion which she must be allowed to exercise as to holding close to or varying from the prescribed routine, much will depend. The course may be called a partial or relative rest-treatment. In this, as in all cases, it is a good rule to put all orders into writing, and the following is the sort of schedule which the patient would receive:

To breakfast in bed, having first taken or, where an attendant is employed, been given a cool sponge bath while lying down. To lie still for an hour after breakfast, neither reading nor writing. To rise and dress slowly. To go for a short walk or to drive or to do some easy and necessary thing for an hour, like a visit, if he be able. He returns to be rubbed, and must rest after the massage for half an hour or an hour. Before and after the rubbing to take a little extra nourishment—soup or bouillon, a glass of milk, or a glass of koumyss. Then comes dinner, and rest in the same way after it. And rest, as I have said before, means lying still, neither reading, writing, talking, nor being in any way disturbed. In the afternoon he has a couple of hours to do as he pleases. The nurse comes in again, and gives, or the patient performs for himself, some active Swedish movements or light gymnastics. After supper he lies down for an hour, and in the evening is left to his own discretion, with instructions that he must be in bed at a moderately early and regular hour. If sleeplessness be a part of the trouble, he starts to go to bed a little earlier, and the nurse makes another visit for the purpose of giving a light rubbing or the drip sheet, or that combination of both already described.

These cases frequently do well with such a routine continued for many weeks. Some men who have been broken down are able in this way to give a fair portion of their time to business without being absolutely cut off from the activities of life for the purpose of treatment.

SWEDISH MOVEMENTS AND MASSAGE.

By BENJAMIN LEE, A. M., M. D., Ph. D.

The day when the whole duty of the physician was comprised in the prescribing of pills and potions, and when anything beyond this was considered *infra dignitatem*, is happily in the past. The scientific practitioner of to-day considers his the whole realm of nature wherein to seek for the means of curing the maladies and relieving the sufferings of those who place themselves under his care. The imponderables, the gases, physics, mechanics—all the forces of the universe—are laid under contribution to enable him to accomplish his beneficent objects. Man is now regarded not simply as a combination of mysterious vital phenomena or a living laboratory of chemical processes and reactions, but also as a machine of wondrous complexity, obedient to the laws of mechanics, whose several components and constituents are to a great extent governed by the same physical forces as control similar elements outside of the living body.

Among the means belonging to this general class of remedial methods none have attracted more attention within the last quarter of a century than Mechanical Therapeutics; and this has been well deserved. Of one branch of this department of the healing art—namely, the so-called "Swedish movements" and massage—it is the purpose of this article briefly to treat. To trace back the history of the employment of exercises and manipulations for purposes of therapeusis, or to show how in all primitive races such methods, more or less scientifically worked out, are and have been always in vogue, would waste the time of the reader.

Fig. 65.

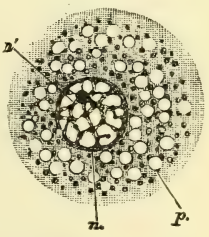
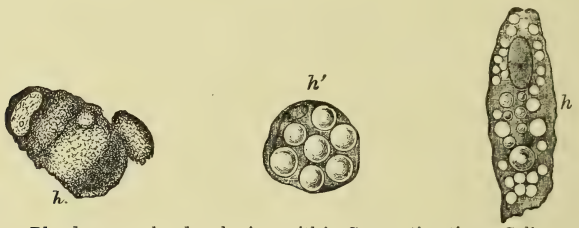


Diagram of a Cell.
p, protoplasm with vacuoles and granules; *n*, nucleus with intranuclear network, *n'*, and nucleolus.

Movement or motion is in modern philosophy the initial of every physical phenomenon or process. Heat, light, electricity, the attractions, are all "modes of motion," to use the generally adopted phrase. In these instances, however, the demonstration of motion is often difficult, sometimes impossible. When we come to the consideration of the living animal, however—the phenomena and processes which we call vital—this dif-

ficulty vanishes. In the primordial cell of every living tissue we are able, with the aid of a microscope, to see this motion going on. This cell is the unit and exponent of life, both in its origin and its perpetuation. We observe the incessant movement of its contents within and through its walls by constant endosmose and exosmose. Irregularity or retardation of this motion constitutes the condition to which we give the name "disease." Cessation of this motion is "death." "Health" is that condition of the individual in which the movements of the cell-contents of all the tissues are normally carried on. It is the

FIG. 66.



Blood-corpuscles developing within Connective-tissue Cells.
h, a cell containing diffused hæmoglobin; *h'*, globular masses of colored substance in protoplasm, within which also are numerous vacuoles; *h''*, a cell filled with colored globules.

function of ordinary muscular movement, such as is necessarily used in the daily avocations of life or instinctively used in obedience to the imperative demand of the muscular sense, to maintain this normal movement of the cell-contents.

It is the function of "remedial" or "localized" or "Swedish" movements and massage to restore this normal movement of the cell-contents when it has become retarded or otherwise disarranged. This therapeutic method, therefore, addresses itself to the very beginnings of life and nutrition, building up the frame anew from the foundation; and hence it is that its reconstructive results are of so permanent a character. Founded upon the strictest inductions of science, and in harmony with the most recent revelations of physiological investigation, it stands upon a plane of certainty in theory and of precision in practice not attainable by the more empirical systems of the materia medica.

FIG. 67.



A view of a portion of Areolar Cellular Tissue, Inflated and Dried, showing the general character of its larger meshes; magnified twenty diameters.

Remedial movements and massage must necessarily be considered together for two reasons: First, because they pro-

duce their effects upon the system through the same channels and in the same manner; and, secondly, because in the vast majority of cases the best results of one cannot be obtained without a recourse to the other. In the most vigorous patients the finer processes of massage are needed to supplement the coarser effects of active movements; and, on the other hand, the sufferer who requires massage is rarely so feeble that, at least, passive movements of the extremities may not be employed with additional benefit.

Swedish Movement Cure.

It is generally admitted that remedial gymnastics owe their renaissance to a Swede, Petter Henrik Ling, a fencing-master in the University of Lund, in the early part of the present century, and their development into an acknowledged system of therapeutics to the fostering care of the Swedish government. The perpetuation of these facts in the name of the system is therefore nothing more than an act of justice. It is sufficient to remind those who object to the expression "cure" as savoring of charlatanism that "cure" (Latin *cura*) does not mean "healing," but simply "care" or "treatment."

The institutions in Sweden where a knowledge of the Swedish gymnastic systems, pedagogic (physical culture) and remedial, can be acquired are the Royal Central Gymnastic Institute at Stockholm and the Universities of Upsala and Lund. At the Stockholm school, where only a limited number are admitted annually, the course of study was formerly two years, but has now been extended to three, the last year being principally devoted to practice. The medical students generally take a few months' course of practical instruction in the movement cure to enable them to write a prescription for movements and to apply them personally if occasion arises. In every city of any importance in the kingdom there are found one or more gymnastic establishments to which physicians can send their patients. Such institutions are always under the supervision of a physician. Three years since a law was passed requiring any one desiring to establish himself as a kinesipathist to obtain a permit from the National Board of Health, and placing every such establishment under the control of the city physician.

In the year 1865, Dr. Gustaf Zander opened an institution in Stockholm under the name of the Mechanico-Therapeutic Institute, in which the movements were administered by means of machinery driven by steam. This method has acquired so much popularity that there are now two such establishments in Stockholm and one in each of other two Swedish cities, and in several places in Germany.

At the United States Centennial Exposition in 1876, Dr. Zander

had a considerable amount of his apparatus in operation, constituting an exhibit of great interest and value. At that time the apparatus of his institution at Stockholm consisted of 67 machines—viz.: 17 machines for active arm movements; 18 machines for active leg movements; 9 machines for active trunk movements; 23 machines for passive movements. The passive movements are worked by a steam-engine of about five horse-power.

By means of these machines the following movements can be executed: 1. Flexion of the arm (at the elbow-joint); 2. Extension of the arms (at the elbow-joint); 3. Twisting of the arms (at the shoulder- and elbow-joints); 4. Flexion of the arms (at the shoulder-joint); 5. Extension of the arms (at the shoulder-joint); 6. Flexion of the hands; 7. Extension of the hands; 8. Adduction of the arms; 9. Abduction of the arms; 10. Upper and forearm extension of the entire arm directly upward; 11. Upper and forearm flexion of the entire arm directly downward; 12. Flexion and extension of the fingers; 13. Flexion of the legs (at the knee-joint); 14. Extension of the legs (at the knee-joint); 15. Twisting of the legs outward; 16. Twisting of the legs outward and inward; 17. Flexion of the legs (at the hip-joint); 18. Extension of the legs (at the hip-joint); 19. Flexion of the feet; 20. Extension of the feet; 21. Adduction of the legs; 22. Abduction of the legs; 23. Hip-knee-foot extension and flexion; 24. Hip-and-knee flexion; 25. Hip-and-knee extension; 26 Foot-rolling; 27. Flexion of the trunk (in the lying position); 28. Flexion of the trunk (in the sitting position); 29. Extension of the trunk (in the standing position); 30. Extension of the trunk (in the lying position); 31. Twisting of the upper trunk; 32. Twisting of the lower trunk; 33. Lateral flexion of the trunk; 34. Extension of the neck; 35. Shaking of different parts of the body; 36. Chopping of different parts of the body; 37. Tapping on the head; 38. Kneading of the abdomen; 39. Kneading of the arms; 40. Rubbing of the feet; 41. Rubbing of the hands; 42. Rubbing of the back; 43. Rolling of the trunk; 44. Swinging of the trunk; 45. Balancing of the trunk; 46. Expansion of the chest,—in all forty-six different movements, most of which may be modified in various ways to suit different purposes.

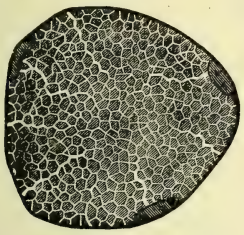
An institution using this machinery has been for several years in successful operation in London. Machines for this purpose have also been invented by Drs. George H. Taylor and Charles Fayette Taylor of New York, and successfully used at their institutions in that city. There are also two or three private medical offices in Philadelphia where apparatus is utilized for the administration of remedial exercise, but without the use of steam. Such apparatus is simply to be regarded in the light of a labor-saving device, enabling a physician

who makes mechano-therapy a specialty to treat a large number of patients with few assistants. The only form of passive exercise which can be given more efficiently by machinery than by the hand of the operator is vibration. For this purpose a machine is vastly superior.

Movements for a therapeutic purpose owe their efficacy to the action of muscular contraction in facilitating the circulation of the fluids of the body, the blood, the lymph, and the areolar fluid. This is of course apart from their purely mechanical value in overcoming deformities.

A muscle is not simply an organ of locomotion. It is a reservoir of blood (Fig. 68). All the processes of nutrition, tissue-metamorphosis, destruction, and reconstruction, molecular death, and cell-renewal are

FIG. 68.



Section of a Muscular Fibre showing Areas of Cohnheim.

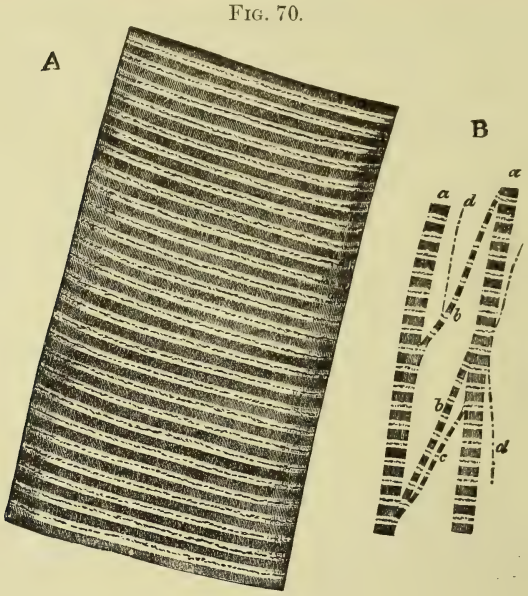
FIG. 69.



Capillary Vessels of Muscle.

carried on in muscular tissue to a greater extent than in any other. To the proper performance of these vital processes the movements of the fluids are essential. Every time that a muscle contracts it forces the blood out of its venous capillaries into the venules, and so on into the venous trunks (Fig. 69). Every time that a muscle relaxes it invites the blood into its arterioles and arterial capillaries, and supplies the incessant demand for oxygen and cell-food. It is a matter of scientific demonstration that heat is evolved, electricity generated, and chemical reactions produced by and during muscular contraction. A free acid (probably lactic) is produced at the expense of the destruction of the hydrocarbons. The formation of carbonic acid is greatly increased. The various substances containing oxygen are decomposed with greater rapidity, and thus made available for tissue-building, and it must be remembered that all general affections involving the processes of nutrition and leading to morbid conditions of the blood depend to a great extent upon suboxidation in the muscle-cell.

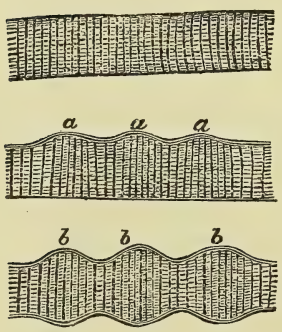
FIG. 70.



Muscular Fibre.

A. Portion of a medium-sized human muscular fibre (magnified nearly 800 diameters). B, separated bundles of fibrils, equally magnified; *a*, *a*, larger, and *b*, *b*, smaller collections; *c*, still smaller; *d*, *d*, the smallest which could be detached (Kirkes).

FIG. 71.



Muscular Fibre contracting, showing condensation of tissue (G. H. Taylor).

Two possibilities, therefore, at once suggest themselves: First, that by the systematic use of the entire muscular system we can improve the nutrition of the whole body; and, secondly, that by acting on certain sets or groups of muscles we can produce a revulsive or derivative action, and thus relieve engorged and congested organs. Further, by developing the muscular tissue to its full capacity we diminish undue nervous irritability. Nothing more need be said to demonstrate the applicability of this method to the relief of all *chronic functional disorders*.

Viewed from a therapeutic standpoint, two modes of contraction are recognized in muscular tissue—viz. *concentric* and *eccentric*.

When the muscle-cells, making a contractile effort, shorten themselves in the direction of the long axis of the muscles, and thus shorten the muscle itself, the contraction is concentric. When the muscle-cells, making a contractile effort, are overcome in this effort by a superior force, and are actually elongated in the direction of the long axis of the muscle, which is itself therefore lengthened, the contraction is eccentric.

Eccentric movement takes place in a muscle under two conditions—natural or physiological and artificial. Natural when the contractile

Fig. 72.



Flexion of the Forearm.
Operator resisting, the biceps contracting concentrically.

force is put forth to just such a degree as to steady the limb moved by the voluntary contraction of its antagonist, thus assuring co-ordination and preventing jerking or spasmodic action. Hence in every natural movement of a sound limb we have one set of muscles contracting concentrically and producing the desired movement, and the antagonistic set of muscles contracting eccentrically, and thus limiting and steadying the movement. If while a muscle is making the effort at concentric contraction we apply such force to the extremity of the limb as to cause it to move in the opposite direction, we produce an artificial eccentric contraction. What is the condition of the antagonist to the muscle which is in this process of artificial eccentric contraction? Obviously, it is not contracting concentrically, because the will-power is exerted in exactly the reverse direction. Nor is it contracting eccentrically, because the force which is applied to its opponent takes away the necessity for the co-ordinating resistance. Hence it must be in an

absolutely passive condition, neither contracting nor relaxing under the influence of the will, but simply gradually shortening, by virtue

FIG. 73.



Forced Extension of Forearm.
The biceps contracting eccentrically.

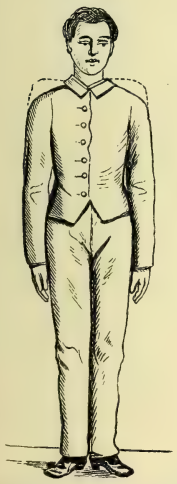
of its elasticity, as its extremities are approximated. All the nerve-force, both volitional and instinctive, is at the disposal of the muscle which is undergoing artificial eccentric contraction. This muscle is therefore receiving the largest possible supply of nerve-force or stimulus at the expense of the least possible outlay to the central nervous system, while at the same time the blood is invited into it by reason of its enforced relaxation. Hence this is the form of contraction which most efficiently aids molecular change in the muscular tissue and promotes its nutrition. At the same time, as it is an essentially active movement of great power, care must be taken that the patient does not exert too much strength, especially if in a condition of lowered vital-

ity. The concentric contraction, on the other hand, is that which aids most directly the onward flow of the fluids in their respective vessels.

The division of movements or exercise into *active* and *passive* is too well known to require description. There is, however, another distinction with which the profession is not so familiar—namely, that of *single* and *duplicated* movements. A movement is called single which is effected by the patient without the aid of an assistant or of machinery. Hence all single movements are active movements. They are usually performed without apparatus, although very light dumb-bells or wands may be employed. When a movement is given with the aid of an assistant, either resisting an effort on the part of the patient or compelling the patient to make a motion which he is endeavoring to resist, this is called a *duplicated movement.* Much of the skill of a practised operator consists in exactly adapting the amount of force which he employs in these duplicated movements to the capacity of the patient, and in teaching the patient to make the movement with such an expenditure of force as shall stimulate the muscle without exhausting its nerve-centre.

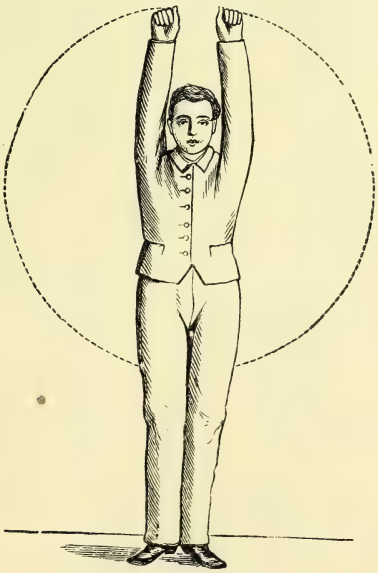
In accordance with the character and degree of motion which the various joints permit in the parts or limbs in which they are sit-

FIG. 74.



Standing or Erect Standing.

FIG. 75.



Stretch standing.

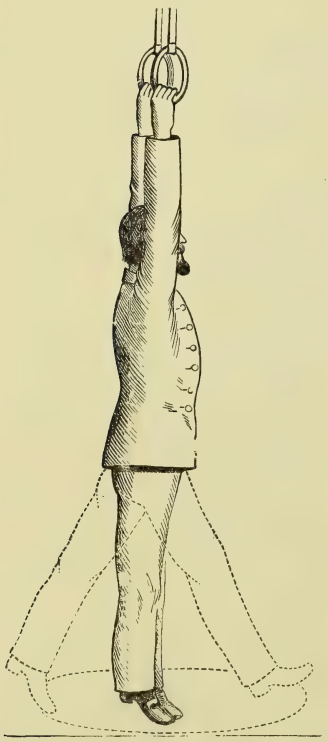
uated, and the groups of muscles which are concerned in the production of the motion, the several movements are divided into flexions and

extensions, abductions and adductions, pronations and supinations, rotations or twistings, and, finally, bendings. These are again specifically described as of the head, trunk, extremities, or subdivisions of the latter. To these may be added stretching, a passive movement of great importance.

In the nomenclature of the different movements it is customary to begin with the posture or attitude in which the patient should be placed in order to make the movement most efficient with the least expenditure of nerve-force.

The principal postures are *standing*, *kneeling*, *sitting*, *lying*, and *hanging*. These primary postures may be again subdivided, but it is unwise to attempt too great a refinement either in attitudes or movements. The Swedish works on this subject are overloaded with a cumbrous nomenclature which wearies the student and reader without offering any corresponding advantage. They are intended to be descriptive, and any physician can invent descriptive titles for himself.

Fig. 76.



Hanging.

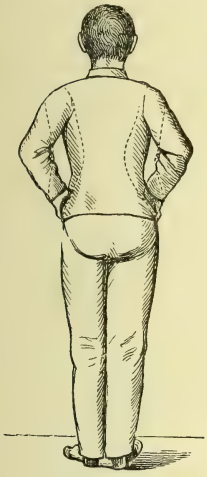
For the various positions of the arms and legs the terms *forward*, *backward*, and *sidewise* or *side*, and *high* and *low*, naturally suggest themselves. There are two quite appropriate terms for two positions of the arms often required—*shelter*, in which one or both hands are placed with the palms resting on the top of the head; and *wing*, with the hand on the hip and the elbow extended. When only one extremity is used in any posture the position is called *half*, Thus, *shelter sitting* means sitting erect with the palms of the hands resting on the top of the head. *Right half wing standing* signifies standing erect with the right hand resting on the hip and the elbow outstretched. This, it will be observed, is a very decided economy in the use of language, and is a saving of time in either speaking or writing.

Stretch signifies complete extension of the upper extremity in any direction.

Stride, the thighs widely separated in either the standing, sitting, or lying position. Various signs have also been introduced to make

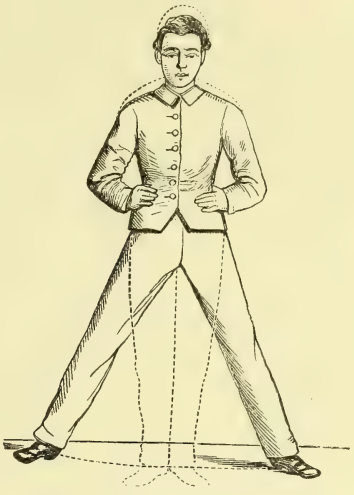
descriptions still more concise, but these, like the signs in stenography, are purely arbitrary, and it is unnecessary to do more than refer to them.

FIG. 77.



Wing standing.

FIG. 78.



Stride wing standing.

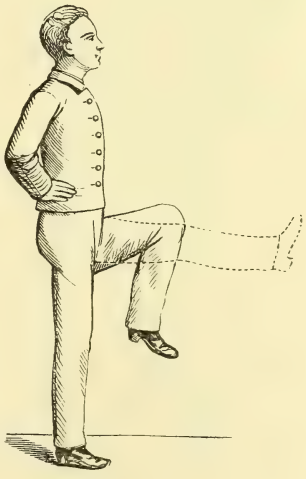
Following the posture is written the part which is to be moved, as head, wrist, thigh, and then the movement which is to be performed

FIG. 79.



Wing standing, leg abducting.

FIG. 80.



Wing crook standing.

and the direction in which it is to be made. Thus, shelter stride sitting, trunk twisting to left, describes a movement in which the patient

sits erect, with the hands crossed over the top of the head and the knees embracing the corner of a couch in order to steady the pelvis, while the operator, standing behind, takes hold of the right elbow with the right hand and places the left hand in a supporting manner against the left side posteriorly. The operator, then making use of the extended arm as a lever, slowly twists the upper portion of the trunk toward the right, at the same time instructing the patient to resist the movement. When the movement has reached its extreme limit, the patient is then ordered to rotate the trunk in the opposite direction, which is done against the resistance of the operator. When it is desired, a particular note may be placed on a prescription, as to whether the operator is to make the movement against the patient's resistance or the reverse, by means of the letters *p. r.* and *o. r.*, signifying *patient resists* or *operator resists.*

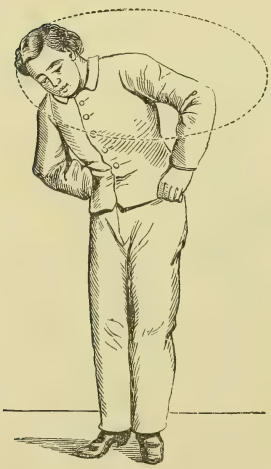
FIG. 81.



Wing standing, side bending.

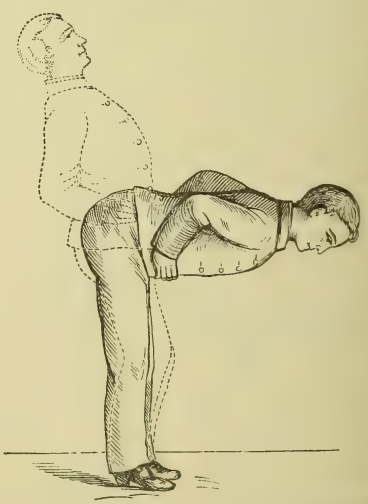
The posture is a matter of much moment, as it ensures rest to such portions of the muscular system as we are not at the moment desiring

FIG. 82.



Wing standing, trunk rotation.

FIG. 83.



Wing standing, forward and backward trunk bending.

to call into play, thus husbanding nervous energy, or throws a certain group of muscles into stronger action, or fixes the origin of particular muscles, or overcomes distortions, or throws certain muscles into a condition of absolute relaxation.

Fig. 84.



Wing standing, knee bending or curtseying.

Fig. 85.



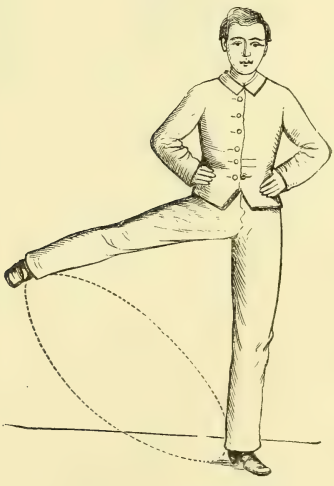
Stride standing, forward bending, or hewing.

Fig. 86.



Half wing, half stretch, standing; forward bending, or sawing.

Fig. 87.

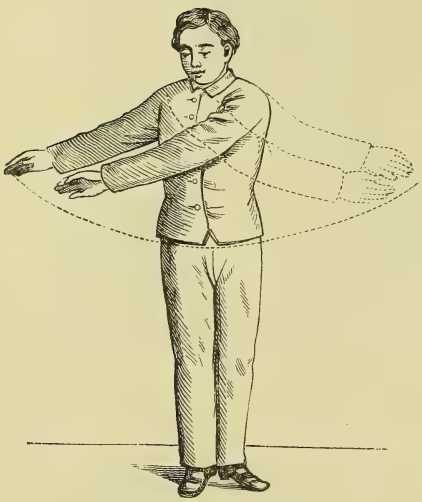


Wing standing, leg circling.

The following is a list of the principal positions of Ling, as given, with slight modification, in Melio's *Manual of Swedish Drill.* These are all active, single movements, standing or kneeling :

		Figure
Primary Positions.	Position or attention position, or standing	74, 88
	Wing standing positions	77, 80, 87
	Neck rest position	—
	Closed standing position	—
	Wing toe stand position	—
	Stride wing stand position	78
	Wing walk position	—
	Neck rest stride stand position	—
	Stretch stride stand position	85

FIG. 88.



Standing, arms circling.

FIG. 89.



Wing, outward lunge position.

Foot, Leg, and Balance Positions.	Stretch walk toe stand position	—
	Wing stand knee bend position	84
	Wing crook stand position	79
	Wing stand lateral bend positions	81, 82
	Stretch stride stand trunk forward bend position	85
	Tense knee bend, or sitting, position	84
	Neck rest knee bend position	—
	Wing outward lunge position	89
	Stretch pass, or forward lunge, position	—
Neck, Trunk, and Abdomen.	Wing stand forward trunk bend position	83
	Wing stand, rear trunk bend position	83
	Half-stretch stand, lateral bend, position	—
	Stretch stride, stand trunk twist, position	—
	Stretch walk, rear trunk bend, position	—
	Neck rest, stand trunk twist bend position	—
	Wing, knee stand, rear trunk bend position	—
	Stretch, knee stand, rear trunk bend position	—
	Stretch, half knee stand, rear trunk bend position	—
	Prone falling or side leaning rest position	—
	Half-stretch, side prone falling, position	—

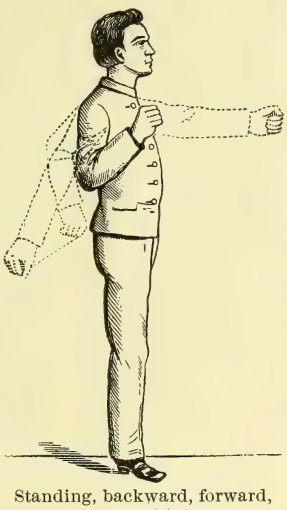
		Figure
Fingers, Arms, and Shoulders.	Stretch position	75
	Half, or alternate stretch positions	—
	Backward (forward, upward, or sideward) stretch position	91
	Upward arm bend position	—
	Forward arm bend position	—
	Outward (upward or downward) fling positions	90

FIG. 90.



Outward stand, outward fling, position.

FIG. 91.



Standing, backward, forward, stretching.

The foregoing selection of terms and movements is merely intended to serve as a key to the numerous positions derived therefrom.

MASSAGE.

Massage may be defined to be the communication of motion to the tissues of the body from an external source for therapeutic purposes. This at once distinguishes it from *movements*, in which, as already said, the motion takes place through the joints and is extended to entire extremities or the trunk; and it also separates it from general *exercise*, which implies in addition volition, and therefore the communication of motion from an internal source.

Let it be clearly understood that neither the Swedish movements, as we consider them, nor massage, nor the two combined, have for their object what is known as physical culture or physical education. That has for its aim—and a most laudable one it is—the symmetrical development of the comparatively healthy human being, muscle and nerve, brain and stomach, and belongs to the domain of hygiene or preventive medicine. The system which we are considering, on the other hand, is purely remedial. This, however, does not prevent the employ-

ment for therapeutic purposes of many of the specific single movements, such as are used in general training. In point of fact, the hygienist has borrowed them from the therapeutist, who first reduced them to a system.

Massage may be *immediate*, when the motion is communicated directly to the part operated on by the hand of the operator, or *mediate*, when some mechanical contrivance is made use of to produce the motion. The word massage comes to us from the Greek through the French language, and signifies kneading, the manipulation of the tissues being somewhat like those of a baker kneading dough; but as the term "kneading" is employed to describe one of the principal modes or varieties of massage, it avoids confusion to retain the French word to designate the general system. Further than this, the term has now an accepted position in the medical vocabularies of all nations. A male operator is therefore a *masseur*, and a female operator a *masseuse*, while the patient is *masséed* (pronounced *massayed*) not *massaged*. The proper pronunciation of the word is *massāzh*, like the first syllable of *azure*.

All the procedures may be placed under four general heads, thus greatly simplifying the nomenclature. These are *stroking* (the effleurage

Fig. 92.



Deep Stroking with Finger-tips.

of the French writers), *kneading* (petrissage, malaxation), *friction* (massage à frictions), and *percussion*.

Stroking is performed over large areas of surface with the palm of

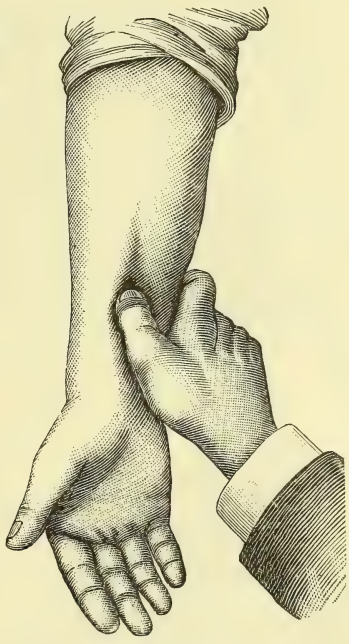
the hand or its radial border (the thumb being abducted), and over smaller surfaces with the pulps of the fingers or sides of the knuckles. The degree of pressure varies with the sensitiveness of the part operated on and the indication to be met, but it should always be sufficiently firm to act upon the areolar tissue beneath the skin and the superficial veins. Except in very rare instances its direction should be centripetal, toward the heart. Every movement of any kind is concluded with a stroking. As the hand which has completed a stroking returns to the

Fig. 93.



Deep Stroking with Finger-pulps.

Fig. 94.

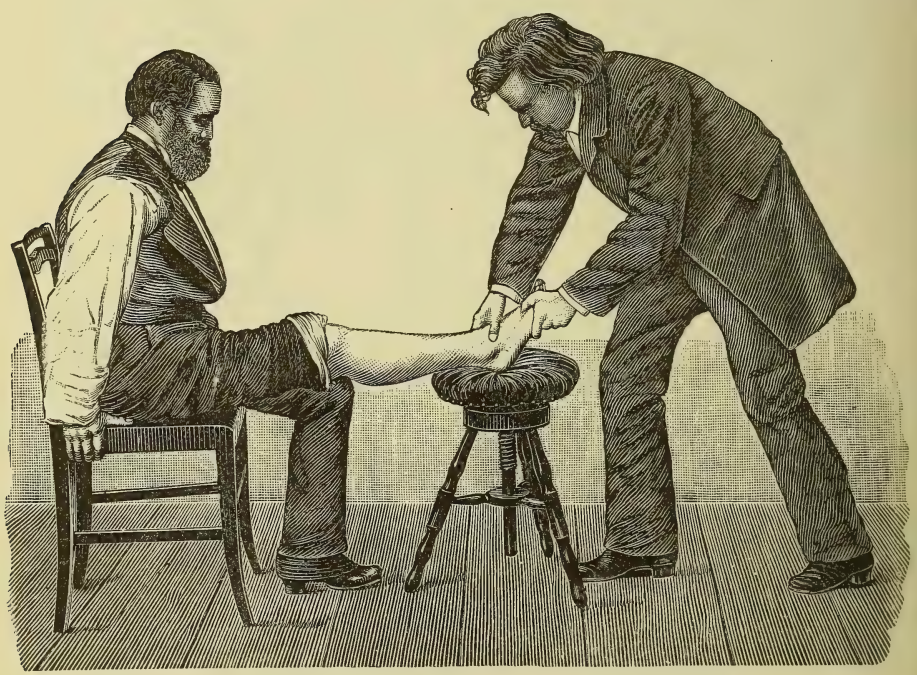


Deep Stroking, or Squeezing.

point from which it started it touches the surface very lightly. In some conditions it may be necessary to use the thumb or the finger held nearly perpendicular to the surface, in order to penetrate deeply between groups of muscles. It is sometimes needful, when the tissues are very rigid or the person obese, to reinforce the operating hand by pressing heavily upon it with the other. The stroking should follow the long axis of the limbs and the direction of the muscular fibres, from the extremities toward the trunk and from insertion to origin. The position of a limb undergoing this manipulation should generally be that of semiflexion, in order that neither the muscles nor the fasciæ may be in a state of tension. The speed of the stroking must be regulated by the general condition of the patient. In the beginning of a

course of treatment the movements should be moderate and gentle, increasing in rapidity and force as the patient becomes accustomed to them. In a weak, nervous, excitable patient they should be less rapid than in one of greater strength or more phlegmatic temperament. In treating the hand the strokes will be carried from the ends of the fingers to the wrist-joint. These may be given at the rate of from ninety per minute to twice that number. The forearm will be stroked from the wrist to the elbow, and the arm from the elbow to the shoulder in one sweep. Both hands may be used, the one returning as the other makes the stroke. And similar areas may be covered in the case of the lower extremities. In the former each hand may make the stroke from seventy-five to a hundred and fifty times a minute, and about the same rate may be used between the ankle and knee; but from the knee

FIG. 95.

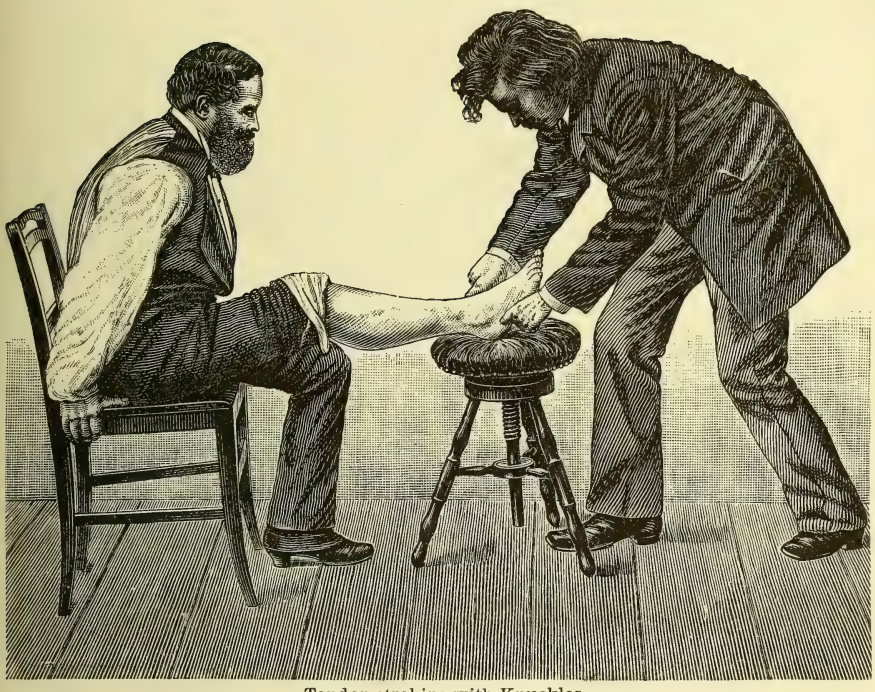


Stroking from Ankle to Knee.

to the hip they will scarcely reach one hundred, or upon the back more than seventy.

Friction.—This consists in forcible circular rubbing over small areas. It may be performed with the full hand or with the tips of the fingers, preferably the latter. It should be constantly alternated with heavy centripetal stroking over very small surfaces, either with the same or the other hand. The thumb is constantly brought into

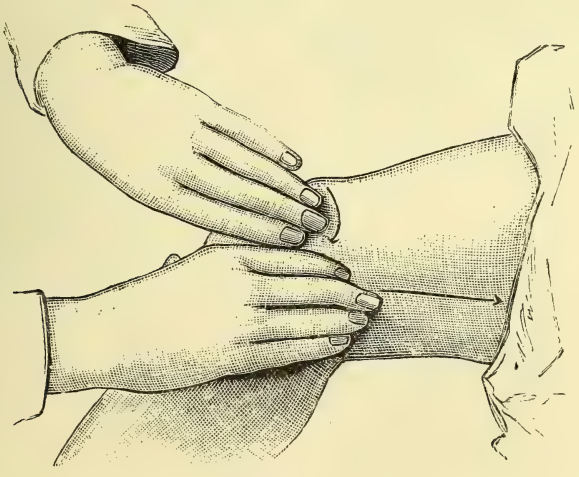
Fig. 96.



Tendon-stroking with Knuckles.

requisition for this purpose. These two distinct movements, the one rotary and the other in the direction of the axis of the limb, may be

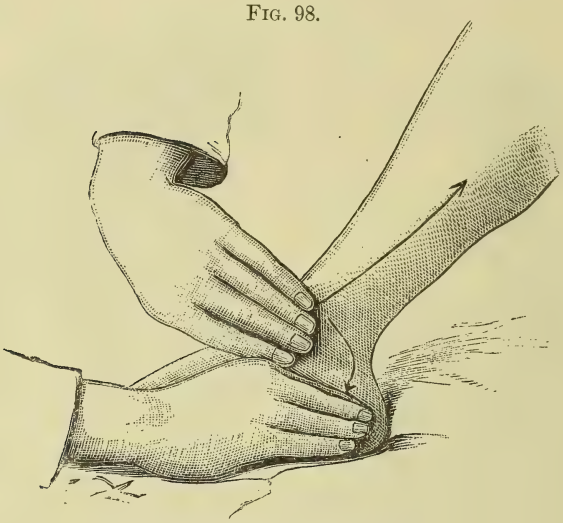
Fig. 97.



Friction of Knee-joint (after Murrell).

made simultaneously with the two hands by an experienced operator. It will be understood, then, that friction, in its technical sense as a

FIG. 98.



Friction of Ankle-joint (after Murrell).

mode of massage, is an entirely different procedure from what is ordinarily termed friction or rubbing. The latter simply irritates the skin and stimulates the superficial cutaneous capillaries.

FIG. 99

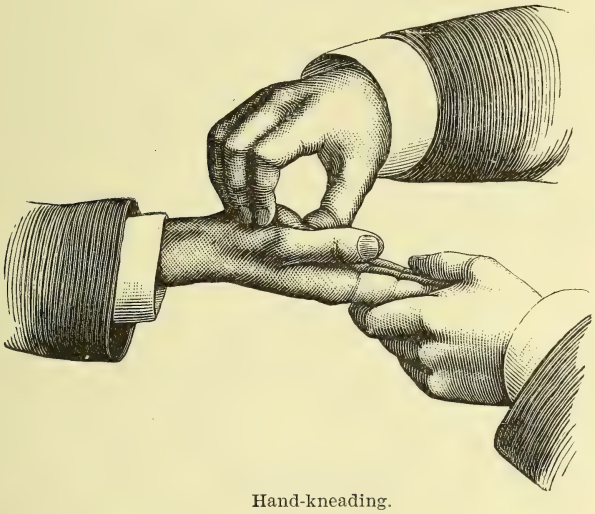


Shoulder-kneading.

Kneading is performed by grasping a muscle or group of muscles or other portion of the tissue, either with both hands or between the thumb and fingers of one hand, and subjecting it to firm pressure, rolling and squeezing it between them or against the underlying substance or organ, as, for instance, a bone. In treating the arms or the leg below the knee the limb is usually grasped by the two hands, one making pressure on the anterior and posterior, and the other on the lateral, surfaces. An amount of pressure must be maintained so that the fingers shall not move over the surface of the skin, but shall carry the skin with them, causing it to move over the muscle. It is essential except in the case of abdominal massage, and

there it is partly true. By alternate pressure and relief from pressure the blood and other fluids are rapidly expelled and as rapidly absorbed

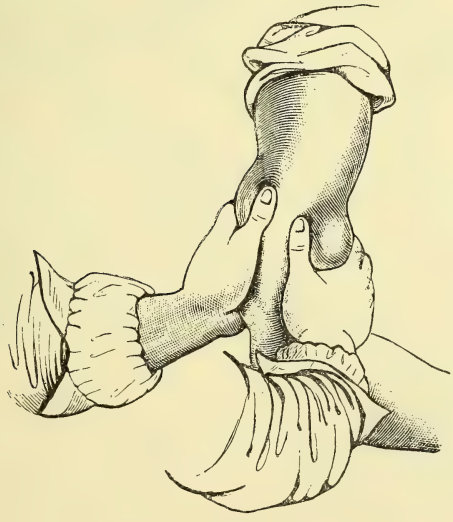
Fig. 100.



Hand-kneading.

from and into the muscular tissue. It should always be begun at the extremity of a limb and continued upward toward or to the body, being

Fig. 101.

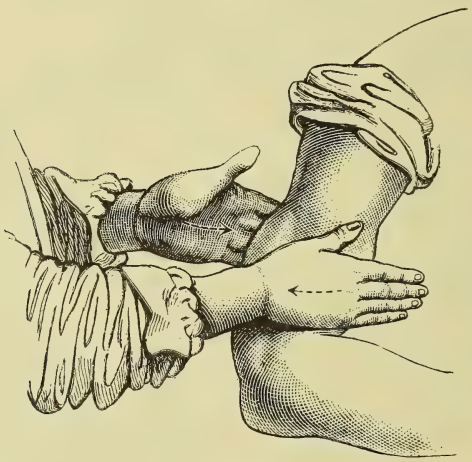


Strong Kneading of the Arm.

careful that every part of the limb is treated. The thumb and fingers are to be held well apart in administering it, and their movement should

be a slightly rotary one. In manipulating very small areas the tips of both thumbs are used, and where we desire to reach single superficial nerve-trunks, as in the scalp, the backs of the thumb-tips. A valuable method of kneading as applied to the limbs is the manipulation known as *fulling*, so named from the motion used by fullers or bleachers in rubbing linen between their hands. It consists in holding the limb between the palms of both hands, with the fingers fully extended, and making a rapid to-and-fro movement with each, the result being that the limb is rolled back and forth between the hands. The alternations of pressure and relaxation are thus made more rapidly than in the method already described.

Fig. 102.



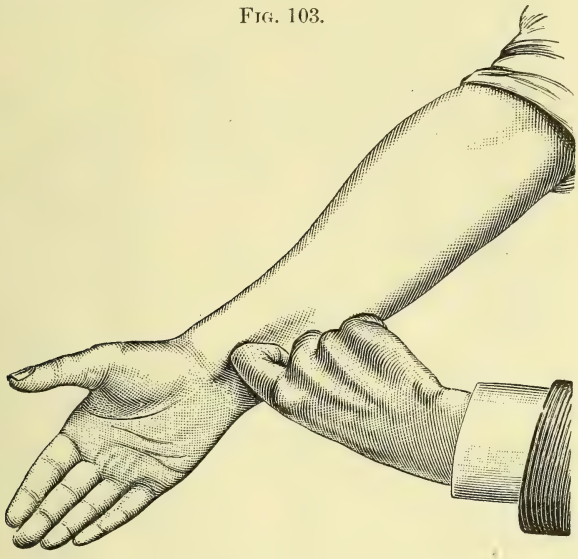
Arm-fulling.

Kneading cannot be executed as rapidly, however, as stroking. Indeed, a certain duration of the successive pressures is quite essential to its thorough efficiency. That of the phalanges of the fingers may be accomplished at the rate of from seventy-five to one hundred and fifty pressures per minute; of the arms, with somewhat less speed; of the legs, from sixty to ninety; and of the thighs, from forty to eighty; while on the broader surfaces of the back and abdomen nearly a second will be required for each movement.

Another important modification of kneading is *vibration*. It consists in making the alternate successive pressures and relaxations, which are the characteristic features of that procedure, with very great rapidity. This may be done with the hand, but requires considerable strength, steadiness of nerve, and long practice. It is accomplished much more effectively by means of some form of machine, of which several have been devised. The reflex, thermal and electrical effects of such a rapid agitation of the tissues are remarkable. The sensation produced is very

similar to that caused by a mild current of electricity. It is a powerful stimulant to secretory action, an excitant of the capillary circulation,

Fig. 103.



Deep Pressure with One Knuckle—Vibration.

and an awakener of dormant nervous energy. The same mechanical contrivance which produces the vibrations may, by a simple change of

Fig. 104.



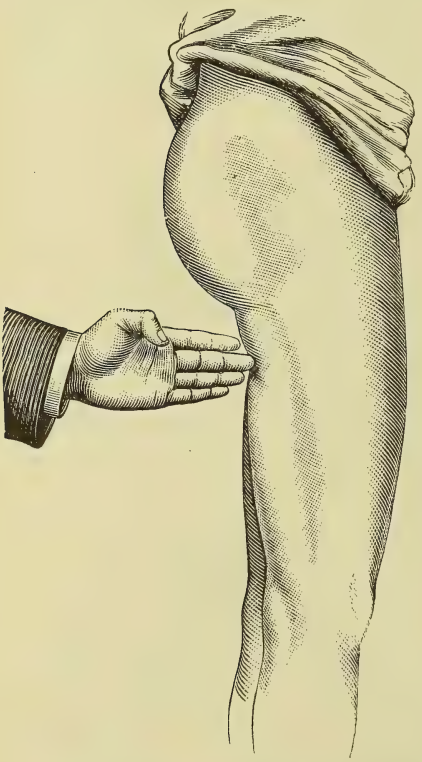
Deep Pressure with Two or More Knuckles—Vibration.

connections and terminal appliances, be made to perform kneading and rubbing.

Midway between kneading and percussion, but properly classed with the former, is *pressure*. This consists in making firm pressure with a small surface, as the tips of the fingers held stiffly or the knuckles. It is used especially when we desire to reach deep-seated nerve-trunks.

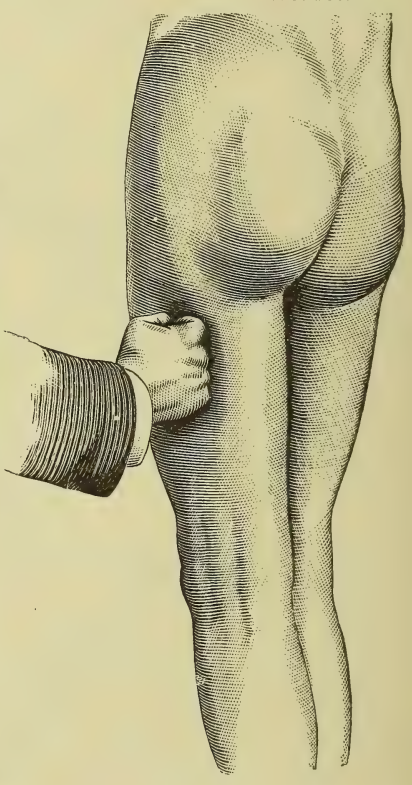
Percussion signifies, of course, striking or beating the surface. We may use either the hand or an instrument constructed for the pur-

Fig. 105.



Pointed Vibration or Thrusting (Deep Pressure).

Fig. 106.

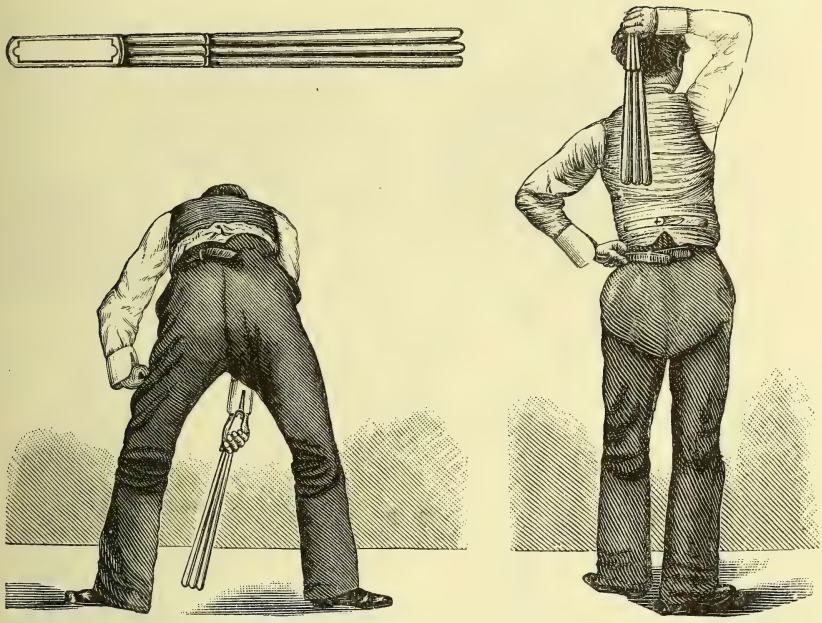


Fist Vibration or Pressure.

pose called a percussor or muscle-beater. Several such are in use, generally made of rubber tubes or balls attached to handles. The best known of these is Klemm's, invented by C. Klemm, director of a gymnastic establishment in Riga. Granville of London has devised an electric percussor, similar to the instrument used by dentists in filling teeth, by means of which percussion may be applied with great rapidity and graduated force over very small surfaces.

Immediate percussion may be modified to a greater extent than any of the other forms of massage simply by delivering the blow with different parts of the hand. The palm of the hand may be used, when

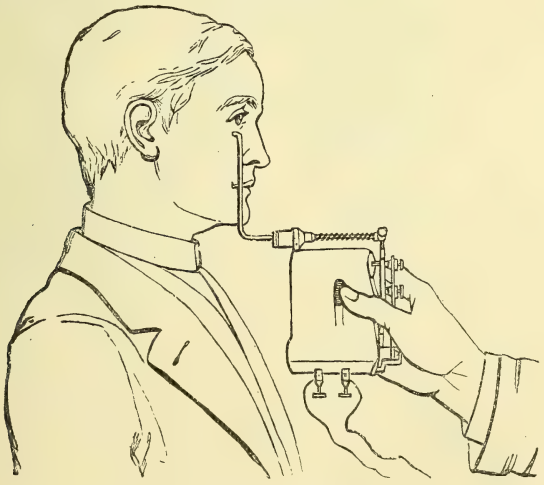
Fig. 107.



Use of the Klemm's Muscle-beater.

the operation is called *clapping;* the ulnar border, when it is denominated *chopping;* the tips of the fingers held stiffly, true *percussion;*

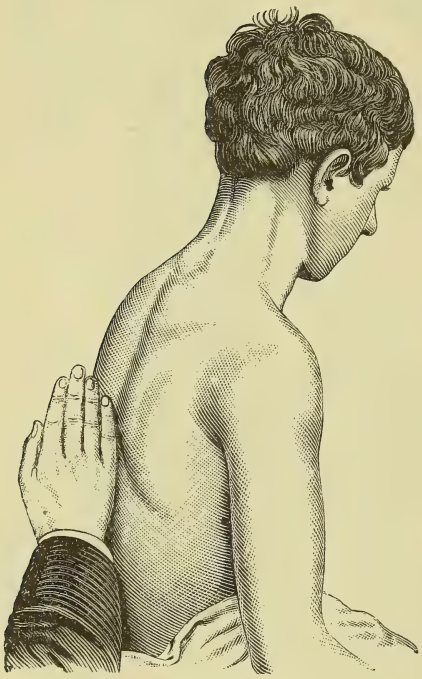
Fig. 108.



Granville's Electric Percussor.

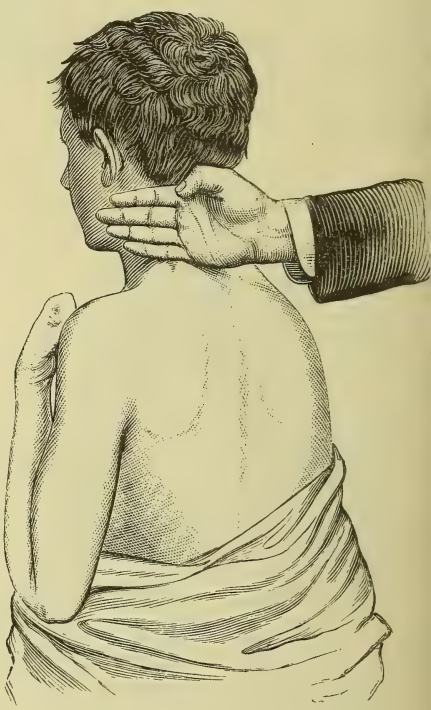
the closed fist or the dorsal surfaces of the two last phalanges of the fingers held rather loosely, constituting *whipping* or *flagellation.* This

Fig. 109.



Back Chopping.

Fig. 110.



Neck and Shoulder Chopping.

form of percussion should be delivered from the wrist with the greatest possible rapidity and only moderate force.

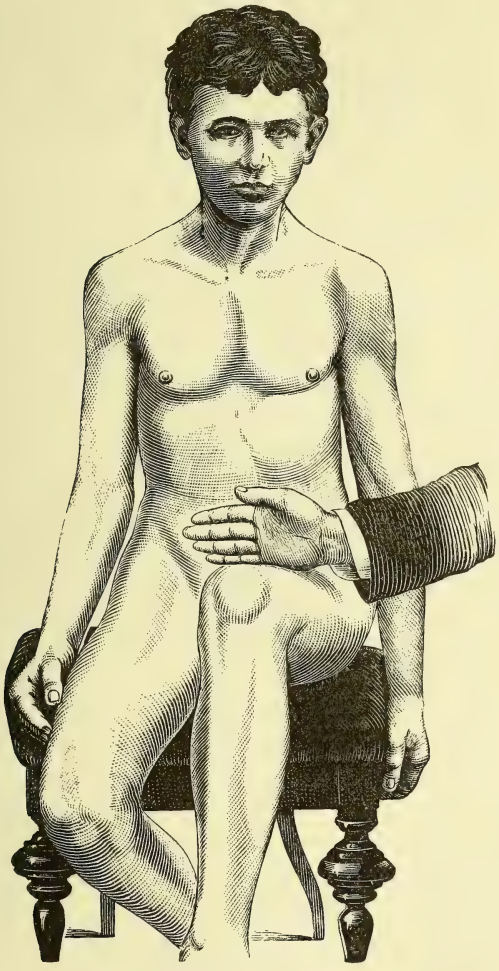
Fig. 111.



Whipping or Flagellation.

The masseur will economize his own force and add to the comfort of his patient by judiciously selecting the areas which may be advantageously included in a single procedure, and also by studying the relative positions of himself and his patient. Dr. Douglas Graham

FIG. 112.



Thigh Chopping.

considers that from the wrist to the elbow and from the elbow to the shoulder are suitable extents of surface to be worked upon with ease. As the lower limbs are larger than the upper, the lateral and posterior aspects from ankle to knee will form a convenient territory, while the lateral and anterior will constitute another.

The operator should stand facing the patient, and, after having completed the manipulation here, without stopping the strokes turn his

back to the patient and continue the operation on the anterior and lateral aspects, each thumb following the other with tolerably firm pressure on the anterior tibial group of muscles.

The same systematic division of surface may be made above the knee as below, but the operator will find that with his back to the patient he will on the whole treat this region with the greatest ease and best results. From the base of the skull to the spine of the scapula forms another convenient region for downward and outward semicircular stroking, and from this latter boundary to the base of the sacrum still another over which one hand can sweep, while the other approaches it, operating on the glutei muscles from their insertion to their origin. On the chest we may conveniently work over each of the pectoral masses, proceeding from insertion to origin.

The same author suggests that in kneading "each group of muscles should be systematically worked upon; and for this purpose one hand should be placed opposite the other, or when the circumference of the limb is not great one hand may be placed in advance of the other, the fingers of one partly reaching on to the territory of the other, so that two groups of muscles may be manipulated at the same time with grasping, circulatory spiral movements, one hand contracting as the other relaxes, the greatest stretching of the tissues being upward and laterally, and on the trunk, forearms and legs, away from the median line." He finds it well to go over each surface gently and superficially before doing the manipulation more thoroughly and in detail. In kneading a leg of considerable size the posterior and lateral aspects will be treated as one region; "the stretching of the peroneal muscles away from those of the anterior tibial region" will require a distinct manipulation, and "rolling of the tissues away from the crest of the tibia" will demand a third. Above the knee one hand will grasp the adductors, while the other embraces the quadriceps extensor, and the alternate contraction and relaxation of the hands will be made in such a way as to stretch these two groups of muscles away from the line of the femoral artery. Proceeding then to the posterior femoral region, the sides of the limb posteriorly will be embraced by the hands, while the fingers reach around to the posterior surface, meeting behind. In manipulating the back, "the muscles on each side of the spinal column can be rolled outward with the ends of the fingers, and the supraspinous ligament can be effectually treated by transverse to-and-fro movements. The ends of the fingers and part of their palmar surfaces should also be placed on each side of the spinous processes, and the tissues situated between them and the transverse processes worked by up-and-down motions parallel to the spine."

Cervical Massage is most effectively performed in the following

manner: The patient should stand with the head slightly thrown back and the shoulders depressed. This is the position in which the neck is

Fig. 113.



Neck Massage (Gerst's method).

most readily reached by the operator, and it affords the broadest surface for manipulation. The patient should be enjoined to breathe quietly, regularly and deeply, in order to promote the flow of blood from the head to the heart and lungs. The special form of massage to be used here is stroking. It may be divided into three acts: The operator stands directly facing the patient, placing the ulnar borders of his upturned palms in the cervical fossæ, so that the little fingers shall pass along the horizontal ramus of the lower jaw, and their ends shall reach the mastoid processes of the temporal bones. While the ulnar borders are now moved downward, both hands rotate, turning the radial borders upward and inward toward the head until they reach the positions first held by the ulnar borders. In this way the entire palm of the hand has been brought into contact with the surface of the neck, while at the same time downward pressure has been made upon the right and left common jugular veins, and upon the pneumogastric and cervical sympathetic nerves, by means of the thumbs; and the superficial veins and lymphatics of the postero-lateral regions have been reached by the palmar surfaces of the fingers. The movement is carried down to the supraclavicular fossæ. When this point is reached the hands are rapidly moved back to the starting-point, lightly grazing the surface; and then the movement is repeated.

If the patient is too feeble to stand, he may sit on a high chair, with the head somewhat bent backward and the upper part of the

chest exposed. The masseur, standing now behind instead of in front as before, places the fingers of both hands in the groove beneath the lower jaw and strokes rapidly downward and outward with a moderate degree of pressure, the thumbs not being called into requisition.

In the case of little children the patient may lie upon the nurse's lap, the head being allowed to fall somewhat backward. The operator then seats himself in front of the child and joins the fingers of both hands over the cervical vertebræ. The thumbs reach forward as far as the larynx, and so the entire neck is grasped. Downward strokings are now made with the thumbs from the border of the jaw to the

FIG. 114.



Neck Massage (method of Béla Weiss).

clavicles, pressure being made at one time on the jugular veins and at another on the sides of the larynx.

Abdominal Massage.—Another region which is deserving of especial reference as regards the mode of its manipulation is the abdomen. Abdominal massage may be performed in several different ways. The first requisite to its efficient performance in most cases is a moderately relaxed condition of the abdominal muscles. To secure this the trunk should be slightly elevated in a reclining posture and the legs semiflexed, with the feet firmly supported. The patient must now be instructed to breathe quietly and regularly, in order not to allow him to stiffen the abdominal muscles. In some patients this tendency is extremely difficult to overcome, and it is surprising what a rigid barrier they are

able to interpose between the contents of the cavity and the hands of the masseur. Laisné's method, which is much followed, is simple and tolerably effective. It is thus described: "The masseur lays his hands on either side of the abdomen, and executes a firm but not violent double rubbing movement, one hand ascending as the other descends, the principal pressure being made by the thenar and hypothenar prominences, and not extending higher up than the transverse colon or lower down than the ileum. On reaching the cæcum the colon is to be followed along its ascending, transverse, and descending portions successively. This manipulation is to be repeated two or three times."

Reibmayr's procedure is somewhat more complicated, but also more scientific and probably more efficient. It is composed of four distinct

FIG. 115.



Abdominal Massage—first manipulation (Reibmayr).

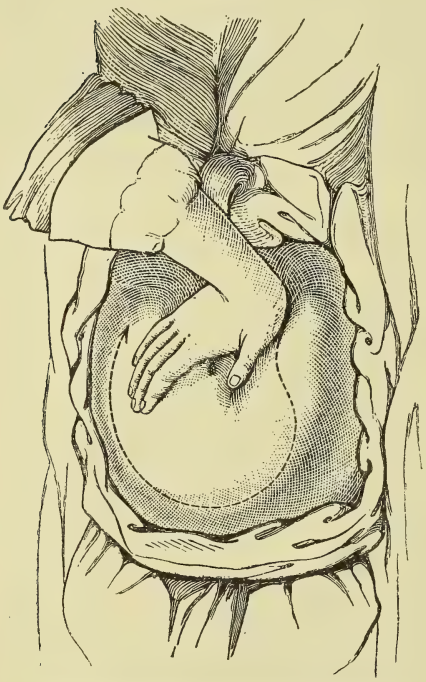
manipulations, which are employed according to the indications, either singly or combined. If the operator desires especially to stimulate the peristaltic action of the intestines, he uses the first and second. If, however, he wishes to act mechanically on their contents, he adds to the second the third and fourth, or employs all three simultaneously.

The first manipulation consists in tracing circles around the umbilicus with the tips of the fingers of the right hand, the end of the thumb lying sideways on the surface, and serving as a movable centre for the motion which is taking place through the joints of the finger and hand. By enlarging the circles and making the pressure alternately light and heavy the power of the application is increased. This

manipulation is irritating to the nerves, and many feeble or nervous persons cannot endure it. For such persons the—

Second manipulation may be substituted. The finger-tips remaining inactive, the circles around the umbilicus are described with the palm of the hand, which is extended as strongly as possible, being held nearly at right angles with the arm. The force is now exerted principally by the heels of thumb and of the little finger. This manipulation adds a certain amount of mechanical action to the reflex stimulation, is effective, and not disagreeable to nervous patients.

Fig. 116.



Abdominal Massage—second manipulation (Reibmayr).

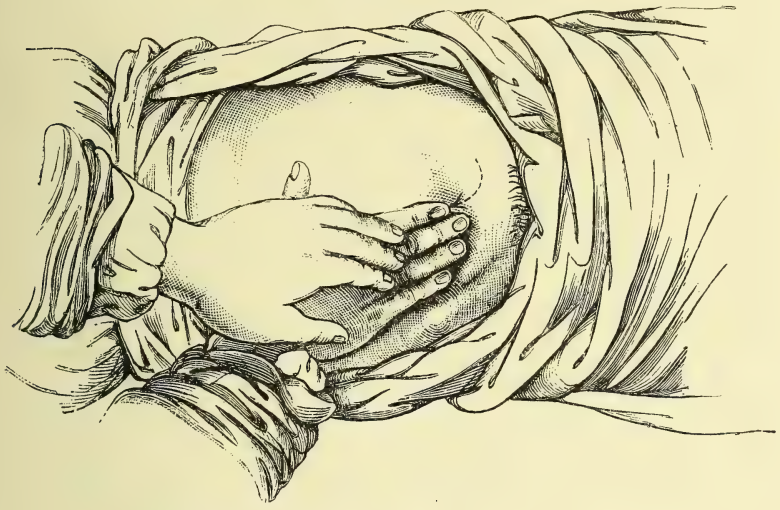
When it is desired to act directly upon the intestinal contents, the manipulations should be directed especially to those portions of the intestinal tube in which fæcal accumulations are apt to occur—namely, the cæcum and the sigmoid curvature of the rectum. The two following methods may then be relied upon:

Third Manipulation.—The right hand is to be applied flat to the right inguinal region, the fingers being directed downward. The left hand is placed on top of the right, pressing strongly on its first phalanges. With the two hands in this position *stroking* is performed from below and within, upward and outward, following the course of the cæcum and ascending colon as high as the borders of the ribs. The hands then pass lightly down over the navel, producing a slight reflex stimulation. The pressure of the left hand upon the right must be so made as to prevent the fingers of the latter from flexing, and thus maintain the opposition of the entire hand throughout the manœuvre.

The fourth manipulation is applied on the opposite side of the abdomen, the tips of the fingers being directed toward the spleen, and the double pressure being applied in the same way. The direction of the motion is reversed—from above and without downward and inward. As the pelvis is approached the fingers should be made to

penetrate as deeply as possible. The operator may kneel, sit, or stand as best suits his convenience in relation to the position of the patient.

Fig. 117.



Abdominal Massage—third manipulation (Reibmayr).

In standing he is of course able to use much more force with less expenditure of strength than in the other postures.

Before leaving the *technique* of massage there are two or three questions which naturally suggest themselves to every physician who attempts to treat his patients in this manner, and which may appropriately be discussed here:

First: What should be the frequency of the séances? This must depend much on the nature of the affection under treatment. As a rule, they should be not less frequent than daily. It is a mistake to suppose that the treatment is so exhausting that a day of rest is needed after each day on which massage has been administered. If this is the case, it shows that the manipulations have been either too severe or too long continued. Twenty-four hours is ample time for recuperation in any condition in which massage is justifiable. An interval of double that extent will only retard the recovery and make the treatment more irksome. There is generally a sense of relief and refreshment after the application, which makes the patient look forward anxiously to the arrival of the next séance. In no case should it be employed less frequently than every other day. Such a use of it is not only time and money thrown away, but may do positive injury and bring discredit on the system. Any one who asks to have massage once a week for the relief of any disease shows an entire ignorance of the laws which govern the effects of exercise on the human body. The rest of

the one day in seven will be of inestimable value to the masseur and of no injury to the patient. The effect of the manipulations of the six preceding days will not have had time to wear off before the impression is renewed on the eighth. The only exceptions to this rule are where the affection is a very painful one or where insomnia is a prominent and distressing feature of the case. In either of these instances the patient may petition for a Sunday séance, which should be granted if possible.

If the treatment is in most cases to be given as often as once a day, there are many instances in which it may be given more frequently with the greatest possible advantage. In convalescence from fevers and acute inflammations recovery will be accelerated by massage given twice daily, late in the forenoon, and about nine o'clock in the evening in order to promote sleep. In sprains treatment twice a day is also indicated. In cases of general paralysis and all forms of muscular atrophy it may be given three times a day with decided advantage. In *general massage,* and especially when the abdomen is to be kneaded, at least an hour should elapse after a meal before the operation is commenced. Otherwise the blood and the nervous energy may be diverted from the stomach to such a degree as to interfere with digestion.

Second: What shall be the duration of each séance? Here the requirements and limitations of each individual case must be considered. If the treatment is given two or three times daily, each application will be shorter than if it is used but once a day. General massage demands from thirty to forty minutes. A sprain may be well and thoroughly manipulated in fifteen minutes. Patients are very apt to make the mistake of supposing that because a treatment of half an hour will produce a certain amount of benefit, one of an hour will produce twice as much.

There is a common impression abroad that when a professional masseur is called in he owes his patient a full hour's services at each visit, and the patient feels that he is not getting his money's worth unless he has the full hour. In point of fact, in the majority of cases of general disease all the manipulating that is done beyond forty minutes is either useless or harmful. There is such a thing as an overdose of massage as well as of opium or calomel. Some authorities go so far as to say that four minutes are sufficient in the majority of cases. Abdominal massage should not be continued more than ten or fifteen minutes. Infantile paralysis demands at least half an hour. When, in the treatment of any particular case, a number of special movements are indicated, as in chronic rheumatism or lateral curvature of the spine, the time must of course be extended.

Third: Should massage be given directly upon the naked skin or with the intervention of clothing? Those who suppose that they convey

some mysterious power of their own, such as magnetism or electricity, to the patient insist strenuously on the importance of contact of the hand with the skin. Others, as Schreiber, consider that the action on the tissues is purely mechanical, and that therefore it is better, both for protection against cold and from motives of delicacy, to have the surface covered with a light flannel garment. More than a single thickness of some quite thin texture certainly interferes very seriously with the efficient and intelligent performance of the manipulations.

Both for massage and for movements the clothing should be of such a character as to allow perfect freedom of motion on the part of the patient, and complete access to every part of the surface by the operator. Hence the ordinary dress must be removed and a special dress substituted. For women a gymnasium costume, consisting of loose or Turkish trousers and a jacket or a blouse not quite reaching the knee, made of some light woollen material, is the most appropriate, and a light slipper without a heel should be worn. It is almost impossible to manipulate properly over a linen garment, as it slips under the fingers. For men an ordinary suit of underclothing or a jersey suit answers every purpose.

As a rule, it may be said that in general massage, where large areas are traversed, and where we desire to act on the deep-seated tissues, the intervention of a single thickness of some light material will not prove a serious obstacle, and, should the masseur have a moist hand, may make the manipulation easier for him and more agreeable to the patient. But when we are working over limited surfaces, as around joints, along the course of tendons, or over swollen glands—when we desire to produce superficial counter-irritation and a derivative action toward the skin, or by light stroking to soothe the nerves and produce sleep—better effects are obtained by treating the bare skin. The majority of patients, women as well as men, prefer to have the limbs treated uncovered. Massage of the abdomen may always be performed through the clothing unless the patient especially desires otherwise.

Fourth: In working directly upon the skin is it desirable to use a lubricant? Here there is a great difference of opinion amongst practical manipulators. Perhaps the majority of writers advise the use of an oil before massage. Schreiber came to the conclusion that so far from being an assistance, in many manipulations it rendered the operation more difficult. Graham considers that the necessity for the use of an unguent indicates want of skill on the part of the operator. Wherever it is necessary to use strong friction over a limited area for a long time, as in the treatment of sprains, inflamed joints, tendo-vaginitis, and the like, the use of lard, vaseline, cocoa-butter, or some such fatty substance will be found useful in preventing abrasion of the sur-

face. If we have in view the reflex, thermal and electrical effects of massage, we dispense with these substances. They are especially desirable when we wish to promote the absorption of extravasations, and the removal of old deposits and effusions into joint-cavities. The value of inunctions in wasting diseases, especially in conjunction with massage following the Turkish bath, constituting what is technically known as the "Roman bath," is not overlooked, but this is quite a different matter, and should more properly be considered under the title of "Baths." In a general way, it may be said that when we are employing this system for surgical affections the use of an unguent is appropriate, but when using it for medical cases it is not called for. Of course, the intervention of such an agent would be a direct obstacle to stimulation of the surface circulation and inviting the blood into the capillaries of the integument, and must be avoided when our object is primarily derivative. In treating ignorant or incredulous patients the use of an oil or unguent may sometimes be desirable in commanding confidence and as a *placebo*. This is especially the case in massage of the eye. In dry massage the operator must be careful when using friction not to use too much force, and especially not to allow it to degenerate into rubbing, otherwise he may produce excoriations which will interrupt the treatment and frighten or disgust the patient.

Fifth: Shall the surface upon which especial attention is to be bestowed be shaved? This will rarely be necessary. Of course, when the treatment is administered over clothing this question cannot arise. In using friction about joints the parts on which the most of the heavy work must be done are usually almost devoid of hair. The cases in which this expedient must be resorted to are more apt to be sprains, in which it is necessary from the outset to employ a great deal of heavy centripetal stroking the entire length of the limb, in order to promote the absorption and speedy removal of the products of inflammation. In these instances, if the limb is unusually hairy or the skin excessively delicate, a careful use of the razor, with extreme caution not to remove any of the epidermis, may be expedient.

Sixth: What amount of force shall the masseur use? This must be proportioned to the nature of the case, the age of the patient, the sensitiveness of the part, and the temperament of the individual. The experienced manipulator acquires great sagacity in judging of all these points. He likewise learns to discriminate between actual suffering and imagined pain as the result of his manipulations. He finds that a pressure or movement which, anticipated by a nervous, hysterical, wayward, timid, or capricious patient, is received with every manifestation of acute agony, will, if he succeeds in engaging the attention of the patient or fixing it on some other part of the body, be borne almost uncomplainingly. When he finds, as a result of excessive zeal,

black and blue spots all over his patient's limbs, he may consider it wise to moderate his energy. These little extravasations are usually the result of too forcible massage administered with too little flexibility of the wrist, and are not calculated, as Schreiber considers, to shorten the duration of the treatment or aid in the cure of the case. The more expert the manipulator becomes, the more rarely will he be called upon to see such marks. It is true that if we have to deal with fungous or spongy tissues or masses of exudation of a low degree of organization, it is difficult to avoid the rupture of small vessels. But these cases are rare, and, except in the instance of individual idiosyncrasy in which there is a hæmorrhagic diathesis strongly marked, if we simply desire to disgorge blood- and lymph-channels in order to remove imflammatory products, it is entirely unnecessary to use sufficient force to produce ecchymotic spots. It is needless to say that they often create an impression unfavorable to the masseur and to the continuance of his care of the case in the minds of the sufferer and of his friends. Moderately firm, gentle, and well-distributed massage is in most cases both more acceptable to the patient and easier for the operator. It will of course be understood that after a course of massage has been persisted in for a time the tissues will have acquired a firmness and resistance which they did not at first possess, and will therefore be less liable to these accidents. It is especially at the commencement of the treatment of a case that caution is requisite in this particular.

Physiological Effects.—In order to understand the therapeutic applications of massage it is absolutely necessary to know something of its influences on the system.

Not the least among the advantages of massage as a remedial agent is the fact that its mode of action is physiological, not pathological. It removes a disease-process, not by substituting for it another abnormal or toxicological process, but by directly substituting a condition of healthy action. Hence, if properly performed in cases in which it is indicated, there need be no fear of unpleasant after-results, such as often follow the prolonged administration of drugs, familiar examples of which are found in the abuse of opiates, of hypnotics, of stimulants and of laxatives. The effects of massage may be arranged under four heads —namely, *mechanical*, *reflex*, *thermal* and *electrical*.

The *mechanical* effects are by far the most important, but the others should not be overlooked or forgotten. They consist, as briefly suggested at the beginning of this article, in stimulation of the interchange of cell contents under the influence of alternate pressure and relaxation; a quickened movement of the blood in the capillaries, especially in the muscular tissue; increased activity in the movement of the areolar fluid; acceleration of the currents of both blood and lymph in their

respective channels; stimulation of the absorbents; removal of obstructions and concretions from ducts; increased secretion of the various organs; the promotion of the peristaltic movement of the intestinal canal; and increased respiratory action and capacity.

Numerous experiments by Ludwig, Weiss, Krause, and others have demonstrated that the principal agent in carrying on the circulation of the lymph, apart from the aspirative effect of respiration, is muscular contraction. If a small glass tube be inserted into a large lymph-duct in a dog's leg, so long as the animal remains perfectly quiet no flow of lymph takes place, but as soon as the paw is moved an abundant stream of lymph gushes forth. In the same way, if we allow the paw and limb to remain at rest, but make use of centripetal stroking and kneading of the leg, the flow again takes place. If, now, inflammation be artificially produced in the paw, and either passive motion or massage be applied, the lymphatics being divided above, lymph will begin to flow. The lymphatic glands, which are not in the least susceptible to electrical stimulus, are also powerfully affected by muscular motion and by the different methods of massage. The experiments of Von Mosengeil are equally pertinent and interesting. They consisted in injecting a thick solution of India ink into different joints in rabbits. Certain of these joints were then subjected to massage, while others were left untouched. In the joints which were thus treated the swelling which resulted from the injections rapidly subsided, while it remained present for a considerable length of time in the others. The animals having been killed, the joints were opened. In those which had been kneaded no ink was found, while in those which had been allowed to remain quiet it was found mixed with the synovial fluid. The muscles of the thighs were then examined, and numerous and widely disseminated black deposits were found in the areolar tissue in those limbs which had been subjected to treatment, and none in the others. A transverse section of the upper part of the thigh of a limb which had been manipulated disclosed deposits of the coloring matter in the intermuscular connective tissue and staining of the crural muscles. In the other limbs the muscles remained of a bright-red color. Still further, the glands of the manipulated limbs above the joints were stained intensely black, and the lymphatics leading to them had the appearance of black cords. No deposits whatever were found in the lymphatic system of the untreated limbs. We are therefore warranted in asserting that massage promotes absorption through synovial membranes, and that pathological products thus absorbed are taken up by the lymphatics.

The effect of massage upon fluid in the peritoneal cavity was studied by Reibmayr and Hoffinger in the following manner: The subjects of the experiments were healthy rabbits. The abdomen was shaved, the

animal carefully weighed, and then tightly secured to a table in such a way as not to interfere with respiration. It was then anæsthetized; a fold of the abdominal wall was raised between the thumb and finger in the left hypogastric region, and a fine exploratory trocar was inserted into the abdomen. Tepid water (35° C.) of a measured quantity was then injected. The animal was unbound, and either left to itself or subjected to massage at regular intervals. At the expiration of a fixed time it was killed by section of the medulla oblongata. The abdomen was then carefully opened, the condition of the peritoneum noted, and the fluid remaining in the cavity measured. The quantity absorbed was calculated from this, and then compared with the entire weight of the body. From these experiments Reibmayr considered that the following deductions could fairly be made:

"1. Under ordinary conditions the normal peritoneum absorbs a relatively large amount of a bland or slightly irritating fluid injected into its cavity; that is to say, 4.57 per cent. of the weight of the animal in one hour, and 7.40 per cent. in two hours.

"2. The absorption takes place with the greatest rapidity immediately after the injection, and, if the animal remains at rest and without the operation of external influences, sinks during the second hour to nearly one-half of the amount absorbed in the first hour; that is to say, from 4.57 per cent. of the weight of the animal in the first hour to 2.83 per cent. in the second.

"3. General massage of the abdomen invariably increases the peritoneal absorption, and to the following extent: in one hour to 9.09 per cent., or 4.52 per cent. of the weight of the animal; and in two hours to 10.29 per cent.; that is, 2.89 per cent. over and above what it would have been without massage.

"4. During abdominal massage the absorption of free fluid from the abdominal cavity is accelerated to the greatest degree during the earlier part of the application, being stimulated to such an extent that in the first hour 9.09 per cent., or 4.52 per cent. of the weight of the animal, is absorbed; in other words, exactly twice as much as without the use of massage. In the second hour, on the other hand, in spite of the massage, only 1.20 per cent. was taken up, not more than half as much as without massage, and only a trifle more than one-seventh of the amount absorbed in the first hour with massage, or about 1.63 per cent. of the weight of the animal less than in the second hour without massage."

The *reflex*, or purely nervous, effects of massage are obtained by *light stroking* and *percussion*. The former produces results which can only be explained on the supposition that it acts as a stimulant to the reflex system of nerves, the force used not being sufficient to account for any change on the mechanical theory. It induces contraction of

the arterioles, and consequent acceleration of the circulation. In some as yet unexplained way it has a remarkable power in soothing pain, which must be due to a reflex impression on the nerve-centres of sensation. Applied along the sides of the neck, it reaches in this manner the great controller of organic life, the vagus nerve and great sympathetic system. Applied over the abdomen in rapid circular strokes, it produces a marked effect upon the peristaltic wave in the intestinal tube. Over the chest, and especially along the insertions of the diaphragm, it noticeably increases the depth of respiration. Tickling is a manifestation of this power, long familiarity with which has led us to overlook its scientific significance. As pointed out by S. Weir Mitchell, we have an ocular demonstration of the fact in the reflex contraction of the cremaster muscle on gentle stroking of the inside of the thigh. The fact that percussion of a muscle or tendon will create a sudden spasmodic contraction of the muscle has long been known. So well satisfied is the mind of the profession as to the character of these contractions that they have been given the name of "tendon reflexes." The most notable of these is that known as the patellar-tendon reflex, the diagnostic value of which is universally recognized. "Muscle reflex" would probably be a more correct appellation. The fact is, that sudden sharp percussion on any muscle in any part of its length will produce a reflex contraction in it. That of the patella is the most easily appreciated, simply from the fact that it is indicated by a long index, the entire leg and foot below the knee. In very thin persons percussion of the pectoralis major will produce a wave of contraction which can be distinctly seen travelling across the chest. This is so noticeable that it has been set down by some observers as a sign of phthisis pulmonalis. It simply indicates a degree of emaciation which permits the muscular fibres to be readily traced beneath the skin.

The experiments of Goltz show that the reflex effects of percussion are not confined to the voluntary muscles, but extend also to involuntary muscles and contractile tissues. This is especially noticeable in percussion of the abdominal walls. The value of the following observation by the last-named investigator cannot be over-estimated: He found that if the heart of a frog were exposed, and percussion were then made upon the uninjured abdominal wall with a blunt implement, the pulsations of the heart gradually became reduced in frequency, until finally it altogether ceased to beat. This stoppage of the heart's action he considered to be due to a true reflex inhibition through the intervention of the vagus. When the inhibitory action induced by vigorous and somewhat protracted percussion began to pass off and the heart again began to beat, an entirely new form of contraction developed itself. Instead of the auricle and ventricle becoming strongly distended with blood during the diastole, and the systole then

forcing the blood in great volume into the aorta, causing it to dilate and lengthen out, the heart received very little blood during its period of relaxation, remaining collapsed and pale, and a very trifling amount of blood was forced into the aorta during the systole. The dimensions of the auricles underwent little or no change, and the venæ cavæ were almost empty. Wounded arteries in the extremities scarcely bled at all. In brief, the condition of the circulation was very similar to that which would ensue after a colossal hæmorrhage. If the animal were left to itself, after a time the pulsations became more pronounced, until finally they returned to the normal standard. This alteration in the heart's action must depend upon an alteration in the active contractility either of the heart or of the blood-vessels. If of the heart, the alteration must be either in the nature of increased or of diminished activity. The author demonstrates satisfactorily to himself by a series of experiments that it is owing to neither of these conditions in the heart itself, or, rather, that these conditions in the heart would lead to no such result. We must look to the condition of the vessels, then, in explanation of the phenomenon. If we subject an animal to the percussion experiment, and then open the abdominal cavity, we shall find the abdominal vessels, especially the veins, dilated and distended with blood. This plethora is the result of a relaxation of their walls produced by the mechanical irritation. After a time the vessels regain their tone under the influence of the central nervous system, and the heart then beats as strongly as before. The sudden dilatation of these vessels may be compared to a suddenly-developed aneurism. The tension which is necessary to propel the blood forward to the heart through the great vessels ceases. But little blood, therefore, enters the heart during its diastole, and it works painfully, like a pump without water. We must conclude, then, that the circulatory disturbances induced by abdominal percussion depend upon a relaxation of the abdominal vessels, and that the restoration of the normal condition is brought about by the active contraction of the same vessels. Further experiments demonstrate conclusively that the contractility of the veins is under the control of the central nervous system primarily, and secondarily of the abdominal ganglia.

In consequence of the powerful influence which this apparently simple manipulation is capable of exerting upon the physiological processes of the body, we must, in its administration, carefully consider the force, number, and rapidity of the blows, the duration of its application, and the locality upon which it is applied; and we shall also find occasion to vary greatly the modes of its application in accordance with the various affections for which we employ it.

As we can, by means of brief and light percussion, develop, first, a contraction, and then, by a continuance of percussion of increasing

severity, a dilatation, and finally a paralysis of the vascular system, so percussion will produce a similar train of effects upon the sensory nervous system. For instance, we observe that if we percuss over a sensitive nerve an increase of pain at first occurs, which, however, rapidly diminishes, then entirely disappears and gives place to complete loss of sensation. The more sensitive the nerve the less force and time is required to reduce it to this condition.

The *thermal* effects of massage and movements are almost too apparent to need scientific demonstration. Every one is familiar with the fact that both muscular contraction in the form of ordinary exercise and simple friction develop bodily heat in a striking degree. Friction, indeed, develops heat to the degree of combustion in inanimate materials, and chafing of the hands and feet to restore warmth is an expedient familiar to us all. Exact observations as to the power of massage in this direction have been made, and are not without interest. S. Weir Mitchell, in his valuable essay, *Fat and Blood, and How to Make Them,* notes what has been the experience of all masseurs, that he has "frequently seen the strangely cold limbs of children suffering from infantile paralysis gain from six to ten degrees Fahrenheit during an hour's massage." In nervous and hysterical women he often notices at first a slight fall in temperature, which is of course attributable to emotional causes. This subsequently gives way to a tolerably constant rise. He has found the most notable rise in "persons who, owing to some organic disease, have a natural liability to great changes of temperature." The following illustrative tables show these facts very clearly:

"Mrs. J——, at rest on the usual diet. Manipulation at 11 daily:

Before Massage.	After Massage.	Before Massage.	After Massage.
100°	100°	$99\frac{2}{5}$°	100°
100	$101\frac{1}{5}$	100	100
$99\frac{2}{5}$	$99\frac{4}{5}$	$99\frac{4}{5}$	100
$99\frac{4}{5}$	100	$99\frac{4}{5}$	100

"Miss P——, æt. 24, hysteria:

Before Massage.	After Massage.	Before Massage.	After Massage.
$99\frac{1}{4}$°	$99\frac{1}{4}$°	$100\frac{1}{5}$°	$100\frac{2}{5}$°
$98\frac{1}{4}$	99	$100\frac{2}{5}$	$101\frac{2}{5}$
$98\frac{1}{2}$	$98\frac{1}{4}$	$100\frac{2}{5}$	$100\frac{3}{5}$
99	$99\frac{3}{4}$	$100\frac{3}{5}$	100

"Mrs. L——, a very thin, feeble, and bloodless woman, æt. 29 years:

Before Massage.	After Massage.	Before Massage.	After Massage.
99°	100°	$98\frac{2}{5}$°	$98\frac{4}{5}$°
$98\frac{1}{2}$	$99\frac{1}{5}$	99	$99\frac{4}{5}$
98	$98\frac{2}{5}$	100	$100\frac{1}{5}$
99	100	99	$99\frac{4}{5}$

"Mrs. P——, æt. 31, feeble and anæmic, nervous, slight albuminuria and chronic bronchitis. Liable to fever, 3 P. M.:

Before Massage.	After Massage.	Before Massage.	After Massage.
$101\frac{3}{5}°$	102°	$100\frac{3}{5}°$	$101\frac{3}{5}°$
100	$100\frac{4}{5}$	$100\frac{2}{5}$	$99\frac{4}{5}$
99	$99\frac{4}{5}$	$100\frac{3}{5}$	$100\frac{2}{5}$
100	101	$100\frac{3}{10}$	$100\frac{9}{10}$
$99\frac{2}{5}$	$100\frac{1}{5}$	$99\frac{1}{5}$	$99\frac{4}{5}$
$99\frac{4}{5}$	$100\frac{3}{5}$		

These temperatures were taken always before 4 P. M., and at intervals of three days. Her morning temperature was usually 99° to $99\frac{4}{5}°$, and in the evening, nine to ten o'clock, it always rose to 100°, 101°, and at times to 102°."

The slight fall in temperature following massage in certain individuals is probably due to increased activity of the sudoriparous glands and consequent surface evaporation.

Kirke, in his *Handbook of Physiology*, says: "The fact that the manifestation of muscular energy is always attended by the evolution of heat and the production of carbonic acid has been demonstrated by actual experiment; and when not actually in a condition of active contraction, a metabolism not so active, but still actual, goes on, which is accompanied by the manifestation of heat. The total amount set free by the muscles, therefore, must be very great; and it has been calculated that the amount of heat produced by muscular activity supplies the principal part of the total heat produced within the body."

Massage of the abdomen alone, without movements, has been found to diminish the temperature of the extremities.

The effect of massage in heightening the surface temperature of the part immediately operated on is much more striking than is its effect on the whole body-temperature, as observed by Mitchell. T. Stretch Dowse of London, in his lectures at the West End Hospital for Nervous Diseases, showed a child suffering from infantile paralysis in whom, the temperature of the ward being 64° F., that of the inner part of the leg was below 70° F. After ten minutes' kneading the temperature had risen 17° F. Twenty minutes' kneading the evening before had increased the temperature to $94\frac{1}{2}°$ F.

The *electrical* effects of massage result partly from the development of surface heat, partly from surface friction, partly from the attrition of the muscular fibres and cells, partly from nerve-stimulation, and partly from chemical action. How far these delicate currents are influenced by the electricity developed in the hand of the operator, and to what extent they influence tissue-metamorphosis, are questions still to be solved by experiment. But, that massage stimulates the electrical contractility of a muscle has been proved by many observers. Zabludowski demonstrated that kneading restored the contractile power of

muscles exhausted by the rhythmical application of maximal induction currents, while simple rest without massage had very little restorative effect. Von Mosengeil, at the request of Murrell of London, applied an electrode to the motor point of the external popliteal nerve, "and gradually reduced the strength of the current until it failed to produce any contraction in the muscles; he then masséed the limb for two or three minutes, after which the current, which had previously failed to elicit a response, produced vigorous contraction." Mitchell, in his work on *Injuries of Nerves*, says: "I have several times noticed that muscles which were previously sluggish, after being thoroughly kneaded would contract far more readily *when faradized.*" Graham similarly observes: "My own observations, repeated almost daily, teach me that muscles give a much more ready, vigorous, and agreeable response to the will and to the *faradic current* after massage than they do before." Dowse made the following demonstration before his class: A child suffering from infantile paralysis was introduced, the affected limb having a surface temperature of 70° F. The poles of a battery were applied to the limb, and eleven milliampères were required to produce muscular contraction. The limb was then masséed, and the temperature was found to have risen to 95° F. The poles being again applied to the same points, contraction followed the employment of only five milliampères. It is evident, therefore, that massage diminishes the resistance of the tissues to the electrical current, and increases the electrical contractility of the muscles.

Let us now consider for a moment the effects of general massage and movements upon the entire system. It may safely be claimed that by the combined use of these methods we are able—

1. To cause an increased flow of blood to the muscles and other vascular tissues, thus increasing the activity of the circulation, and promoting tissue-metamorphosis and the removal of effete material.

2. To strengthen muscular fibre, and, by setting up molecular vibrations, to induce changes not only in muscle- and nerve-fibres, but retroactively even in the nerve-centres.

3. To promote the absorption of effusions and exudations and to break up adhesions.

4. To increase the oxidizing processes in all the tissues, but especially in the muscles.

5. By what may be termed physiological counter-irritation or derivation to relieve local stasis and congestion of the internal organs at will by compelling the blood to flow into the great muscular reservoir.

6. To act directly upon the sympathetic nervous system, thus stimulating secretory action.

7. To act through reflex nervous influence upon involuntary and unstriped muscular fibre.

8. By symmetrical and normal development of the entire muscular system to restore lost counterpoise between that and the nervous and vegetative systems, and to overcome irregularities in muscular action and distortions depending upon them.

Observations on the effects of general massage on persons in ordinary health have been made by Zabludowski, Gopadze, and Von Mosengeil. Zabludowski's experiments were made upon himself, his servant, and his housekeeper, all adults in early or middle life. All lived under precisely the same conditions, and careful examinations of weight, muscular strength, temperature, pulse, respiration, and urine for eight days previous to, during, and eight days following the ten days of daily massage. The result was an increase of muscular strength in all; decrease of corpulence in one and increase of weight in one; increased excretion of urates and phosphates in the cases in which weight was reduced; decrease of urates and increase of sulphates in the case in which the weight was increased. In all a general elevation of the functions of life, increased appetite, and more refreshing sleep were noted.

Gopadze selected four medical students as his subjects. They were treated by *centripetal stroking*, beginning at the extremities, followed by *kneading*, *friction*, and *percussion*, the treatment terminating with a repetition of the stroking. In all the cases the appetite was increased, not only at the time, but for a week or two following the week of massage. The amount of nitrogenous transformation was augmented. During the week two gained and two lost in weight, but during the week following all gained. The temperature in the axilla fell slightly. The respirations increased in frequency and depth. The pulse was slightly accelerated by light stroking, and somewhat retarded by kneading, but with either it became fuller and remained so for an hour.

Therapeutic Applications.

Having thus become acquainted, somewhat cursorily, with the mode of administering movements and massage, and their physiological effects upon the system, we are prepared to consider the classes of diseases in which their employment is likely to prove efficacious, and the manner in which they may be prescribed to the best effect in certain affections and conditions. It may be said, in a general way, that whenever we desire to modify profoundly the processes of nutrition, to remove effete material from the system, to stimulate assimilation and invigorate digestion, to soothe nervous irritability and relieve nerve-pain, to arouse dormant nerve-force, to remove morbid deposits from, and from the neighborhood of, inflamed joints, and thus restore their normal mobility, to equalize the circulation, drawing the blood from the hot head, congested abdominal viscera, or laboring heart, and accelerat-

ing its passage through the cold extremities,—we may find a safe resource in this system.

As a rule, it is contraindicated in acute febrile affections, except in the form of light centrifugal stroking for the purpose of quieting nervous excitement and promoting sleep. The one exception to this rule is the case of membranous croup, in which it is often an aid to the dislodgment of the false membrane. Kneading, friction, and light percussion are the appropriate methods to be resorted to for this purpose.

Let us now take up the separate systems of the human organism, and consider the applicability of massage and movements to the relief of the diseases and derangements of each.

Diseases and Disorders of the Digestive System.—It is probably in its effects upon derangements of digestion, taking the term in its widest sense, that the medical profession has been inclined to place the most faith in the employment of massage and movements, and not without reason. Dyspepsia in its various manifestations, constipation, diarrhœa, intestinal obstructions, including hernia and intussusception, chronic catarrhs of the stomach and bowels, engorgement of the liver, catarrh of the gall-duct, and gall-stones, are all treated mechanically with excellent results.

Dyspepsia.—It is principally in the atonic form of gastric indigestion that this method is successful. This is characterized by deficient peristaltic action of the muscular coat of the stomach and bowels, deficient secretion, flatulent distension, a sense of præcordial oppression, palpitation, and cold extremities. It is important in treating affections of the stomach to allow a considerable period of time—at least two hours—to elapse after taking a meal before beginning massage. The position of the patient during massage should be such as to relax the abdominal muscles to the fullest extent. Sitting with the body somewhat inclined forward, and with the elbows resting on the knees, answers well. Abdominal kneading, vibrations, and mild percussion over the organ are the forms of massage to be employed. The movements must be such as bring into play the abdominal muscles, both straight and oblique, increase the respiratory movement and play of the diaphragm, and stimulate the general circulation.

Reibmayr considers that massage is indicated—either alone or as a supplement to the other modes of treatment—in acute and chronic gastric and intestinal catarrhs, dyspepsia, cardialgia, dilatation of the stomach, intestinal obstruction (ileus), tympanitis not dependent upon inflammation of the peritoneum, ascites, and, finally, all the sequelæ of peritoneal inflammation, such as firm peritoneal or extra-peritoneal exudations, swellings, and adhesions; always provided that the inflammatory process is completely at an end. All inflammatory

affections of the peritoneum, malignant tumors, and deep ulcerations of the stomach or intestines contraindicate its employment.

Rubens-Hirschberg speaks well of the beneficial effects of massage in many affections of the stomach. In cases of dilatation, for example, in which the muscular tissue is weak and the food is too long retained, it excites this viscus to contraction, and by determining a flow of blood to the parts improves its nutrition. It increases the secretion of the gastric juice, and is especially useful in atonic dyspepsia. It relieves the symptoms of pain, weight, and discomfort from which dyspeptics frequently suffer, and is one of the best remedies for flatulence, quickly expelling the accumulated flatus. By stimulating the nerves of the stomach it is beneficial in many gastric affections of nervous origin. The best results are obtained in cases of chronic dyspepsia due to catarrh of the stomach associated with dilatation. In the dyspepsia of anæmic or chlorotic girls it yields equally good results. The increased supply of blood to the walls of the stomach is inimical to the formation of gastric ulcer, but when once an ulcer has formed the employment of massage is distinctly contraindicated, as it might give rise to perforation. It should never be resorted to when malignant disease is suspected.

Murrell observes that in dyspepsia and other functional disorders of the digestive apparatus massage is most useful. Applied to the abdomen, it is a powerful stimulant to both the gastric and biliary secretions. Gopadze and Shpoliansky have shown that under the influence of massage food is retained in the stomach a much shorter time than usual, and in cases of slow and difficult digestion kneading, alternating with intermittent pressure with the warm hands, has been found by M. Dally to be most valuable.

The following prescription will simply serve to indicate the character of the movements to be employed. It is of course susceptible of many modifications :

1. Opposite standing, longitudinal spine chopping.
2. Relaxed inclined standing, abdomen kneading.
3. High opposite standing, leg backward pulling.
4. Hook-half lying, stomach vibration.
5. Sitting, alternate trunk twisting.
6. See No. 4.
7. Half stretch high-side-sitting, sideways flexion.
8. Half lying, leg extension.
9. Stretch sitting, arm-flexion with knee-spine stroking.

In the large majority of cases dyspepsia is associated with constipation.

Constipation.—Murrell does not exaggerate when he says : "For constipation it is certainly one of the most powerful therapeutic agents

at our command. Kneading of the abdomen is the best method, care being taken to make the requisite manipulation in the direction of the ascending, transverse, and descending colons. It should be associated with different varieties of percussion—the flat open hand, the hand partly closed so as to form an air-cushion, and the margins of the hands, being employed according to circumstances. Vibratory movements are in addition resorted to in obstinate cases. Mechanical vibration is especially serviceable." Years ago Piorry advocated a mode of treatment for constipation which is not essentially different from that now described. Auerbech says: "Disorders of the digestive apparatus, and especially constipation, constitute one of the most marked indications for the employment of massage. When there are no complications, but the symptoms are due to disordered secretion, one can always effect a cure in one or two months, or, at the outside, three or four. Massage answers admirably for women who suffer from this condition, especially when there is a lax condition of the walls of the abdomen resulting from frequent pregnancies. It is of the greatest service, too, in constipation associated with obesity, and in that form of constipation which frequently results from taking too little exercise."

Reibmayr believes that he is not saying too much when he asserts that "*for habitual constipation, especially in persons of sedentary habits, abdominal massage, combined with pelvic gymnastics, constitutes the most desirable, sure, and efficient remedy that we possess.*"

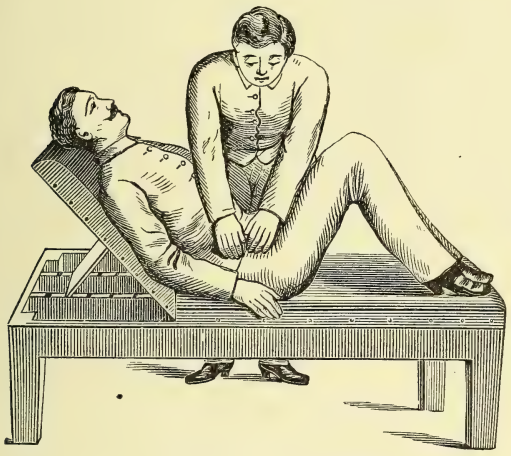
Recurring to its physiological effects, we should bring it into use in all those affections in which we desire to regulate the peristaltic movements of the stomach and bowels; to exert a favorable influence on the circulation of the blood and of the lymph, so closely dependent upon those movements, and hence to act secondarily on the secretion and excretion of the digestive juices; to expedite the absorption of exudations; and, finally, to dislodge obstructing fæcal masses in the intestinal tube by direct mechanical action.

In this connection Graham observes: "Atony of the muscular coat of the stomach or intestines, with deficient peristaltic action and consequent disturbances of digestion, accompanied with distension from flatulence or solid contents, is usually benefited to a marked degree by appropriate massage after ordinary exercise and other measures fail. That benefit is more likely to follow here from repeated treatments than as an immediate effect would show that the nerve-centres that preside over these functions have undergone a nutritive change which it has taken time to produce, and hence that the improvement would most likely be lasting. Moreover, when the alimentary canal is distended by gas or overburdened by solid contents the nutrition of its walls must suffer from languid circulation, as any muscular organ

would that was continually stretched and inactive. Massage improves the circulation, and pushes along the contents of accessible portions of the stomach and intestines at the same time, besides directly stimulating the muscular fibres to contraction and reacting on the nerve-centres, thus improving function and organization in various ways."

Virchow refers portal congestion to two prime causes: First, to disturbed innervation of the muscular coat of the arteries and veins, leading to loss of tone, the elastic fibres gaining the preponderance. In consequence, the vessels become dilated and relaxed, the blood flowing sluggishly, just as any stream flows more slowly when turned into a broader bed. Secondly, to venous congestion from diminished cardiac power. All kinds of digestive difficulties naturally develop from these

FIG. 118.



Hook-half lying, colon kneading.

circulatory disturbances. The distended portal venous radicles lose, to a great extent, their absorptive capabilities, and the lymphatics being unable to meet the increased demands made upon them, it follows as a matter of course that the food-mass remains in the stomach and intestines an abnormal length of time. In consequence of this, all sorts of fermentative changes go on in the mass, the products of which, being absorbed in the blood, give rise to a general disturbance of nutrition. The thus altered contents of the alimentary canal by irritation of the mucous membrane cause reflexly all kinds of nervous symptoms, such as nausea and vomiting, colic and cramps, and, as the result of chemical changes, eructations, heartburn, and sour and bitter tastes. The coexisting constipation too, by barring the way for the escape of those gases which are always developed during digestion, gives rise to flatulency.

These are just the conditions, it will be remembered, which mas-

sage is calculated to relieve, stimulating innervation, promoting absorption, exciting the contractility of the venous radicles, and hastening the passage of the digested food-mass through the intestinal tube.

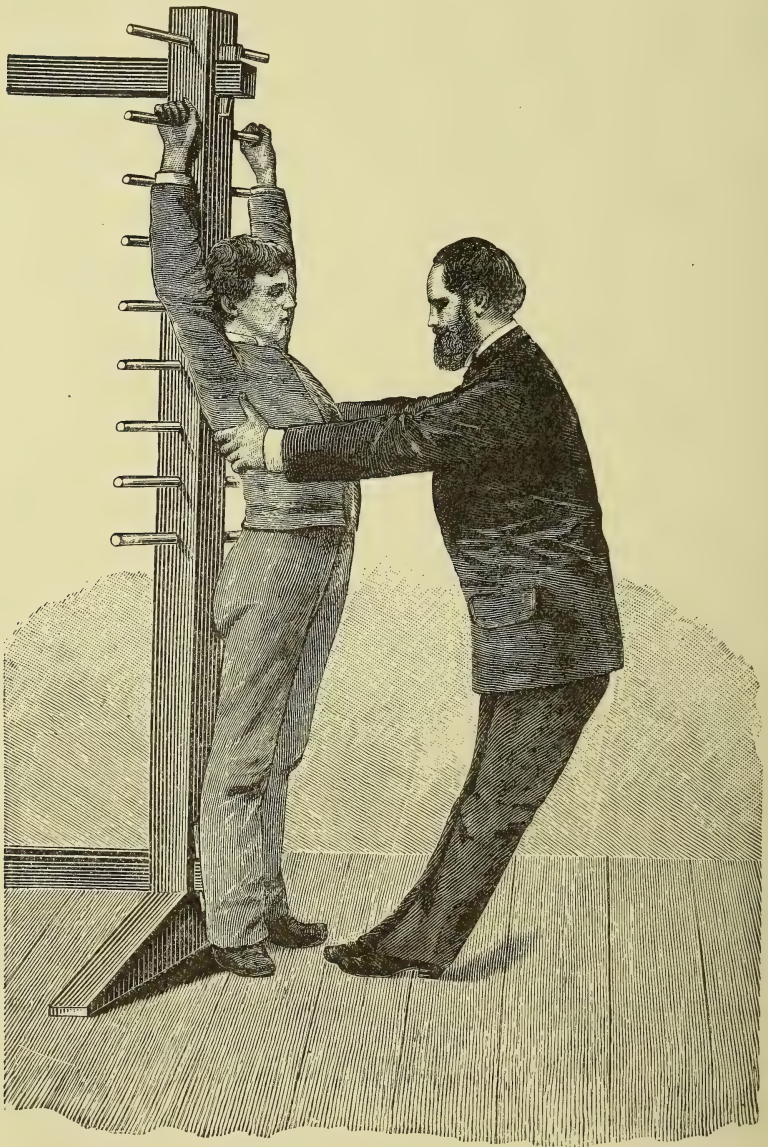
Bueler, as quoted by Murrell, considers that "the physiological effects of massage in the treatment of constipation may be classified as follows: (1) The mechanical action, which is the most important of all, and is not limited to the gastro-intestinal contents, but extends also to the large abdominal secretory organs, removing obstructions of their ducts. This is shown by the success of massage in cases of fæcal accumulation, jaundice due to obstruction of the common bile-duct, ileus, invagination, volvulus, etc. These mechanical effects are best produced by kneading, which breaks up impacted fæcal matters, and by stroking, which facilitates the excretion of materials loosened by the former manipulations. (2) The reflex effect of massage is shown by contraction of the involuntary muscular tissue of the intestine which follows stimulation of the abdominal parietes. This effect is best produced by percussion. Many cases of habitual constipation can be cured by manipulations of this kind alone. This is well illustrated by the case of a student who had suffered from constipation for five years, and who was permanently cured after a course of treatment of eight weeks' duration, the percussion being resorted to three times a week. (3) The thermic action is shown by observations already related in detail. This action is allied to the treatment of constipation by the application of hot poultices to the abdomen and to certain hydrotherapeutic measures. (4) The chemical action is more hypothetical. It is suggested that abdominal massage, whilst causing marked hyperæmia of the local integuments, gives rise to an arterial anæmia and venous hyperæmia of the peritoneum, with an accumulation of carbonic acid in the intestinal circulation leading to increased peristalsis. The problem of the practitioner in every individual case of constipation," says this author, "is to find out which of the therapeutic elements of massage is most suitable and promising —whether the procedure must aim only at strengthening the tonicity of the abdominal muscles or must act mechanically or in a reflex or thermic manner." This question being settled, the procedure can be considerably simplified by omitting all unnecessary manipulations. We must strongly condemn the routine practice of massage in all cases without discrimination, and insist on the strictest adaptation of the treatment to each particular case. Manipulations which lead to a rapid cure in one group of cases may be followed by injurious consequences in another. Thus, in case of chronic constipation due mainly, if not entirely, to weakness and flabbiness of the abdominal walls, as in women who have borne many children or in men advanced in years with big pendulous bellies, such manipulations as forcible separation of the abdominal recti by the insertion of the tips of the fingers

between the edges of the muscles along the linea alba are indicated. The muscles contract forcibly, and this action may be intensified and prolonged by transverse stroking in an outward direction from the medial line. Concurrently with this, the diaphragm should be strengthened by deep inspirations performed forcibly and regularly, as in the practice of artificial respiration. On the other hand, in cases of constipation due to atony of the intestine, such as occur in persons of sedentary habits, the treatment must consist of gentle, gradually intensified, and more powerful stroking, followed by moderately strong percussion with the palm of the hand. In constipation due to dyspepsia, complicated perhaps with dilatation of the stomach, the manipulation should consist of stroking, limited to the gastric area. Two cases of this kind treated in this way twice a week were permanently cured in a month. The massage must be similarly localized in cases of fæcal accumulation in the cæcum or sigmoid flexure. In habitual constipation dependent on cerebral or spinal neurasthenia, especially common in hypochondriacal or hysterical subjects, only such procedures as percussion and stroking are indicated. In this connection Mr. Treves says: "With regard to its effect in cases of fæcal accumulation it must act largely as a mechanical agent, influencing the conformation of the stercoral mass and modifying its position. It would appear also to act as a direct stimulant to the intestine, for within a few minutes of the commencement of the manipulation peristaltic movements are excited, which may in time reach such a grade as to cause much colicky pain. It is possible that such an effect may be brought about by the immediate stimulation of Auerbach's plexus, under the control of which the peristaltic rhythm is supposed to lie. The stimulation also of the skin of the abdominal parietes may not be without influence. It is supplied by branches from the last seven of the dorsal nerves, and it is significant that it is from these very nerves that the splanchnics are in great part derived. The part played by the splanchnics in the abdominal nervous system need not be commented upon. Their precise influence upon the bowel has yet to be established, but, as far as movement is concerned, they appear to contain both excitor and inhibitory fibres."

Berne of Paris points out, very justly, that before undertaking the treatment of a case of constipation by massage it is essential to make a careful examination with the view of determining the absence of any contraindication, such as a tumor or chronic inflammation. The hepatic region should also be examined to see whether there are biliary calculi in the gall-bladder, for if there are care will have to be taken not to make too great pressure on the adjacent parts of the transverse colon. Berne's conclusions may be briefly summed up as follows: (1) Abdominal massage is the best method of treating constipa-

tion which has resisted other remedial measures. (2) No single sitting should exceed twenty minutes, and there should be from the first at

FIG. 119.



Span-standing, chest-forward pulling.

least one a day. (3) A natural action usually takes place after about the sixth application, and the beneficial effect continues long after the cessation of the treatment. (4) Pressure should be exerted over the

fundus of the gall-bladder, so as to induce it to contract and assist the progress of the bile toward the intestine. (5) Massage induces a more abundant secretion of the gastric juice and stimulates the contraction of the muscular coat of the large intestine. (6) In addition to stimulating reflex action, massage acts mechanically, and under its influence intestinal changes take place more actively.

Considerable space has been devoted to the treatment of this condition, because, first, we find it associated, either as cause or effect, with almost every other affection we are called upon to treat; secondly, it is in itself one of the most frequent of all disorders; and, thirdly, because abdominal massage is one of the most difficult of the combined procedures of massage, and must be done skilfully and with intelligent discrimination in order to obtain good results.

The following is a specimen prescription for this most common and troublesome of all derangements of the system among civilized peoples:

1. Opposite-standing, curtseying, abdomen and loin pressure.
2. Sitt-lying, raising, knee support.
3. Relaxed inclined sitting, side abdomen vibration.
4. High-ride sitting, trunk rotation, abdomen and loin pressure.
5. Span-half hook standing, knee downward pressure.
6. Hook-half lying, suprapubic pressure.
7. Span-standing, colon stroking.
8. Span-standing, high-twisting.
9. Span-standing, chest-forward pulling.

Diarrhœa.—The indications for the employment of remedial movements in diarrhœa are not so apparent as in constipation, and yet on reflection they will be found to exist. In the first place, diarrhœa, as is well known by all practitioners, often indicates that somewhere in the intestinal tube there is retained a mass of irritating material, which by its presence provokes a profuse secretion of watery mucus, and which at the same time only allows the more fluid portion of the intestinal contents to slip by it. Such a mass being found by careful manipulation, it is only necessary to get rid of it to accomplish the principal part of the cure of the diarrhœa. Secondly, there is usually present in chronic diarrhœa a relaxed condition of the tissues generally, and especially of those of the intestine. A general development of the tone and vigor of the voluntary muscles is always followed by increased tone in the non-striated muscular fibres wherever found. Derivation of the fluids of the body to the extremities will naturally diminish the intestinal flux and promote general nutrition and a purer blood, and therefore less irritating secretions.

All the movements in the earlier part of the treatment must be passive. Kneading of the abdomen, unless for the removal of an impaction, must be carefully avoided. Vibrations and gentle percussions

will be of great service. Instead of insisting on a position which will relax the abdominal walls, it is better to have the limbs extended and the muscles slightly tense. In this way we are able to stimulate without producing irritation.

Asiatic Cholera.—Whether cholera should be considered a disease of the digestive or of the nervous tract is an open question. Certain it is that some of its most striking and terrible manifestations are in the domain of the latter. One of the most potent means of overcoming the frightful cramps which accompany it is general massage. By means of persistent stroking and kneading the spasms are soothed, the capillary stasis is overcome, the circulation of the blood is restored, and collapse is succeeded by healthy reaction. This has been a successful method of treatment in India for centuries.

Functional Derangement of the Liver with or without congestion or engorgement is almost invariably an accompaniment of prolonged indigestion and chronic constipation or diarrhœa. Hence, when we are called upon to treat this condition, it is usually masked by these affections and has existed for a long time unsuspected by the patient. The liver and spleen are accessible to both direct and indirect treatment. Direct massage can be made available only when these organs are enlarged, and therefore but partly covered by the ribs. Simple hypertrophies of the spleen and liver, not dependent upon new growths, may be designated as favorable objects. The liver may also be reached indirectly. The circulatory relations of this organ are, as is well known, intimately connected with the blood-pressure in the intestinal vessels, and especially in the portal system. But this pressure, again, is principally influenced, whether favorably or unfavorably, by the tension of the contractile elements of the intestinal walls, the muscular coat, and still further by their peristaltic action. By stimulating the peristaltic movements, therefore, we can influence the intestinal circulation, and through it the degree of blood-pressure in the liver. The latter being the efficient agent in the secretion and excretion of the bile, this function thus comes under the domain of the indirect powers of massage. From what has been said, the special diseases in which its employment is indicated will readily occur to the reader—viz. hepatic congestion and jaundice. In *chronic hepatic congestions*, especially with considerable enlargement, Durand Fardel has found massage well suited to give relief. Together with local massage (stroking) over the region of the liver, general massage of the abdomen should be made use of at least once daily for fifteen minutes.

The liver is so situated that it is quite amenable to massage. It can be reached by percussion and vibration through the chest-walls, the right hand being thrown above the head to render the latter tense. By inclining the trunk forward and relaxing the abdominal muscles the

lower border of the liver and part of its under surface can be reached. In this way not only can the sluggish and distended gall-bladder be emptied and its fluid contents be sent out to do their appropriate work in intestinal digestion and disinfection, but by cautious manipulation gall-stones, even when long impacted, can be dislodged. When such an obstruction exists, the distended bladder can generally be felt without much difficulty, and by steady pressure upon its fundus, with gentle stroking toward its mouth, it may be made to expel the obstructing substance. Several successful cases of this kind are recorded by Dr. George Harley. These cases are so instructive as to be worthy of attention. They are detailed by Dr. William Murrell, in his *Masso-Therapeutics*. In one instance Dr. Harley succeeded in safely extruding into the intestines of a lady, aged fifty-five, a gall-stone the size of a small hazel-nut which had been for many years impacted in her bile-duct and had brought her to the verge of dissolution. In another case, as the result of fifteen minutes' manipulation, he expelled two facetted sharp, angular gall-stones the size of beans, affording such immediate relief that the patient experienced no difficulty in searching for them himself in the motion which speedily followed.

The third case is so remarkable that it is given in full as Harley related it. The patient was a lady sixty years old, who had suffered for twenty years with dyspepsia and flatulent colic. "When first called to her bedside," he says, "I diagnosed a gall-stone firmly impacted in the common bile-duct; and as I proposed to subject her gall-bladder to digital manipulation in order to force the impacted concretion out of the duct, it was arranged that as soon as possible she should proceed to London. The distance was only fifty miles, and yet such was the fatiguing effect of the railway journey upon her that when she arrived in town she was in a state of collapse, from which she did not sufficiently recover to admit of my beginning the treatment for three days, and it was not until a week more had passed that the impacted stone was successfully dislodged from the duct, and only after four days more was it discovered in the stool. The stone, which was of the size of a small field bean, proved on analysis to consist almost entirely of cholesterin, and, although it was not facetted, there was no doubt in my mind that it was one of many, for I could feel the gall-bladder quite distinctly as a hard ovoid body, the size of a man's fist, about three inches to the left of the umbilicus and immediately below the enlarged liver. A daily course of digital manipulation of the gall-bladder was accordingly recommended and had recourse to, with the result that over seventy gall-stones were found in the stools during the subsequent seven months. At the end of that time, the gall-bladder appearing to have been completely emptied of all its calculi, the patient left for the country; and it is no exaggeration to say that, soon after, all

the dyspeptic symptoms which she had suffered from for years previously disappeared. In this case rarely more than one gall-stone was voided at a time, though occasionally, after a biggish one had for six or seven hours blocked up the duct and caused jaundice before coming away, two or three smaller ones rapidly followed its extrusion, without producing any other symptoms than a trifling epigastric discomfort. It must be added that the calculi differed very much both as regards their naked-eye appearances and chemical constitution, some being almost white, others brown, and not a few blackish-green—differences no doubt arising from the stones having been formed at various times and under different conditions during the twenty or more years the patient had suffered from the biliary derangements which had not only been originally diagnosed, but always previously treated, as severe indigestions."

Gopadze speaks well of the influence of massage in catarrh of the common bile-duct. The symptoms observed in fourteen cases were jaundice, vomiting, loss of appetite, and constipation alternating with diarrhœa. Massage in the region of the liver effected a cure, on the average, on the eighth day.

Intestinal Obstructions may be due simply to obstinate constipation, the stercoral mass becoming so large and firm, and so closely embraced by the irritated bowel, that nothing can pass beyond it, or the obstruction may be due to intussusception, volvulus, or hernia. Whether due to impacted fæces or to other causes, it produces vomiting, sometimes stercoraceous in character, local pain, and great prostration. Careful manipulation reveals the hardened fæcal tumor, oftener in the neighborhood of the ileo-cæcal valve than at any other point, sometimes at the sigmoid flexure or in the rectum. In manipulating such a mass it will be useless to attempt to force it on by a *vis a tergo*—perhaps dangerous. Strokings, at first very gentle, then gradually increasing in force, should be begun some distance beyond it, toward the rectal end of the gut. These should gradually approach it, thus as it were inviting it onward. By kneading of its rectal end, and gradually of the whole lump, it may be pressed out, elongated, and finally broken up, and carried on by firm strokings in the direction of the axis of the canal. Percussion would here manifestly be out of place. Much gentle persistence and patient labor is the key to success.

Intussusception.—If in such cases we detect a stercoral mass, it is always well to break it up by persistent careful kneading, as its presence at the point of involution is an interference with the disentanglement of the bowel. Stroking in different directions will then often result in the restoration of the canal to its patent condition.

Hernia has been treated by massage from time immemorial. The diagnosis of hernia and the description of its various seats

would be foreign to the purpose of this article. Suffice it to say, that massage and posture are appropriate to all forms and locations of hernia. The proper manipulations for the reduction of strangulated hernia are thus described by Agnew: "In the hands of unskilful men the taxis serves to put things very much out of order, and it should be undertaken only under a clear apprehension of the regional anatomy of the hernia and the rationale of the force to be employed. Some proceed, it would seem, under the impression that the work is to be done by force; others act as though the whole manipulation consisted in pushing. Now, it should be clearly understood that neither the one nor the other is proper—that the parts must be handled with great gentleness, and not rudely, otherwise inflammation may be provoked or even rupture of the sac of the intestine may follow. When the force is applied by pushing the mass upward, it will merely crowd the contents of the sac against and around the seat of stricture or force them into some side-pouch. The two dominant thoughts in the use of the taxis are to steady the neck of the sac and to empty the intestine of its contents, for by so doing the disproportion in size between the bowel and the rings is lessened. As soon, therefore, as the patient is rendered insensible and the parts are properly relaxed, the surgeon, if the hernia be an *inguinal* one, places the thumb on one side and the fingers on the opposite side of the external ring, so as to prevent the sac from bulging over the pillars of the latter; with the other hand he grasps the body of the tumor, and, first drawing it downward and outward in the line of the canal, so as to straighten the cavity of the bowel, he begins to compress the hernia with a moderate degree of firmness, graduating the force in such a manner that, with the exception of the fundus, where it should be greatest, the pressure shall be evenly distributed over the tumor. This compression must be maintained continuously for eight or ten minutes, when perhaps a peculiar sensation will be felt and heard (gurgling), caused by the air passing out of the rupture. This is the sure precursor of reduction, and in a few moments more the sudden slip of the entire contents back into the abdomen will be noticed. When the omentum alone is the occupant of the sac, the restoration is effected slowly, one fold after another of the membrane receding until all is replaced.

"In applying taxis to *femoral* hernia, should the tumor have turned upward over Poupart's ligament it must first be dragged down into the groin, after which the thumb and fingers of one hand should be placed on opposite sides of the saphenous opening, while with the other the rupture is compressed and simultaneously pushed backward and slightly upward, in order to direct it into the saphenous opening and through the femoral ring into the body. There is a limit to the use of the taxis. If the reduction is not accomplished in ten minutes, our efforts should

cease and resort should be had at once to the knife. A large or an old hernia will tolerate a longer manipulation than a small or a recent one. In any event, taxis should not be persisted in for more than ten minutes. Not unfrequently the hernia has been subjected to prolonged manipulation before the surgeon is called, and, if there is reason to believe that the taxis has been used properly, it will be better to confine further efforts at replacement within the limits of five or six minutes. When, from handling, the hernia has become exceedingly sensitive or painful, and when there is reason to believe that mortification has begun in the contents of the sac, taxis is not allowable. Mr. Birkett thinks that the presence of hiccough contraindicates the employment of taxis. This is the case when, associated with the sudden subsidence of pain, there are present a feeble, frequent pulse and cold sweats, with extreme prostration, as these are the signals of commencing mortification; but hiccough is sometimes present when there is no evidence whatever that the vitality of the hernial contents is destroyed, and under such circumstances manual attempts at reduction should not be withheld.

"Surgeons sometimes place the patient in unusual postures as adjuvants to the taxis; such, for example, as laying the person on an inclined plane, with the head and the shoulders low and the limbs bent over on the abdomen, or suspending the individual by the heels, or simply raising the pelvis upon a pillow, the thorax and lower limbs being at the same time flexed upon the body. Another device consists in grasping the relaxed parietes of the abdomen and pulling them as far forward as possible. A folded sheet has been passed around the lower part of the body and the viscera forcibly drawn upward.

"Inguinal hernia is much more frequently restored by taxis than is femoral; and it should not be forgotten that, as a rule, the last form of hernia is much less tolerant of manipulation than the first.

"In attempting the reduction of *strangulated femoral* hernia, the patient should be placed under an anæsthetic, the head and shoulders well raised, the leg on the affected side flexed upon the thigh, and the latter bent upon the pelvis, with the knee turned inward toward the opposite side. This position ensures the most complete relaxation of the structures about the saphenous opening. The surgeon now draws the tumor down upon the thigh, should it have turned up over Poupart's ligament, and then, after using steady, gentle compression to its sides for one or two minutes, pushes it backward into the external femoral opening, and at the same time upward in the direction of the internal femoral ring. The reduction will be favored by placing the thumb and fingers of the other hand on the margin of the saphenous opening in order to prevent the contents of the hernia from overlapping its sides. To secure the full benefit of taxis it is absolutely necessary that the practitioner should understand the anatomical peculiarities of

the femoral region. The three movements demanded for reduction by the relation of the hernia to the region through which it descends are the following: downward, backward, and upward. If these have been properly tested for six or eight minutes without success, an immediate resort to the knife will be necessary.

"In order to reduce a *strangulated umbilical hernia* the patient should be placed under the influence of an anæsthetic, the head and the shoulders raised, and the limbs drawn up so as to relax the abdominal parietes. The surgeon next grasps the tumor with one or both hands, according to its bulk, and after drawing it forward in order to elongate and consequently narrow its contents, he compresses it with a view to displace the flatus, and, lastly, pushes the contents of the rupture upward and backward. If a certain portion of the hernia be more tense and resistant than the rest, the taxis should be addressed to that part, as it is highly probable that the obstruction is dependent upon the presence of a loop of intestine in addition to that ordinarily within the sac."

Obesity, or **Corpulence**, is a condition depending in some unexplained way on defective digestion—probably intestinal—and faulty assimilation. Few morbid conditions, not painful, cause their victims more physical discomfort or mental annoyance. It embarrasses respiration, impedes the circulation, circumscribes muscular activity, and often renders locomotion difficult, if not impossible. A nitrogenous diet, with avoidance, as far as possible, of hydrocarbons, is of course to be recommended. Combined with this, massage and movements are of the greatest possible service. Our first object must be to stimulate the great emunctories, and thus provide an outlet for the fatty detritus which we propose to send to them later. First among these are the liver and intestinal epithelium—the former not so much for the amount of excrementitious matter which it throws out as for the value of its secretion as a scavenger in sweeping away the débris of epithelial desquamation, uncovering the outlets of the excretory ducts, and stimulating the renewal of their cells. Vigorous abdominal massage, with special reference to the liver, is therefore the first indication. To begin with movements of the extremities would only result in forcing a turbulent and muddy stream onward to a reservoir whose outlets are clogged and obstructed, thus damming up the current, damaging the sluice-gates, and leaving morbid deposits in the abdominal glands and viscera. By stimulating the abdominal nerve-centres by means of the reflex and electrical influences of rapid superficial stroking, and following this up with deep strong kneading, the secretions are first augmented, and the peristaltic action is then stimulated to carry them off. Strong percussion of the liver with the full palm of the hand, already described as *liver-clapping*, is then to be

employed, followed immediately by pressure on the fundus of the gall-bladder, if possible, for the purpose of increasing the secretory action of that organ and of mechanically hurrying the bile through the gall-ducts and out into the intestinal canal. Next, in order to call the reinforcing power of the spinal cord to the aid of the splanchnic and sympathetic nerves, rapid percussion of the spine must be made use of, the blows being delivered with the finger-tips, beginning at the base of the brain and going down to the sacrum, especial attention being given to the lower half of the dorsal region. This is to be followed by the usual back-stroking, in order to soothe any undue nervous irritation that may have been caused. Vigorous duplicated flexions and extensions of the thighs, with the view of compelling the abdominal muscles to contract strongly, and also by the action of the psoas and iliacus muscles to stimulate the pelvic circulation, will conclude the treatment, which should be administered daily for the first week, and after that twice a day.

Diseases of the Circulatory System.—It is certainly contrary to all our preconceived notions that exercise *per se* should be beneficial in *diseases of the heart.* Rest would seem to be the first indication. In point of fact, the movement cure has won some of its greatest triumphs in this class of cases. To understand this we must bear in mind the strong compensatory efforts which nature makes in all valvular affections of this organ, adapting the capacity of its cavities and the thickness of its walls to the demands made upon it by altered mechanical conditions. No one pretends that the organic changes which have taken place in the valves themselves can be remedied. To what extent a pure blood is capable of dissolving growths of low vitality upon their surfaces we do not know. But we do know, as already stated, that coincident with increased tone of the voluntary muscular system, taken as a whole, we have also increased tone of the involuntary muscle-fibre wherever found. We also know that stasis in the venous capillaries, and consequent defective circulation and imperfect nutrition, are invariable accompaniments of cardiac affections. This capillary congestion is relieved by massage and by such a carefully regulated system of movements as shall develop the general muscular system without draining the nerve-force or unduly exciting the respiration.

Lauder Brunton says: "We all know how active exercise increases the appetite. Tissue-change goes on more rapidly in the organs, waste is more abundantly excreted, and more food is eagerly sought for. But there are many feeble, flabby persons who cannot take exercise, or, if they can, will not. Moreover, there are others who are quite willing to exercise the voluntary muscles of the limbs, but cannot exercise the involuntary muscles of their internal organs. Now, treatment by massage helps both of these. It increases the nutrition, both

of the voluntary muscles and of the internal organs, and under its use patients apparently incurable completely recover."

Graham aptly describes the assistance given to a laboring heart by massage in the following language: "Exercise accelerates the action of the heart and diminishes blood-pressure, which means an increase in the rapidity of the current and in the quantity of the flow through the relaxed, distended, or stretched blood-vessels. Massage also diminishes blood-pressure, but without increasing the activity of the heart. On the contrary, the heart's action is generally lessened in force and frequency. And, on reflection, this is what might be expected, for gravity and the friction of the blood against the walls of the vessels are natural obstacles to the circulation, and these, working backward to the heart, have to be overcome at each systole of the left ventricle. These hindrances are by massage, both directly and through the medium of the vaso-motor nerves, in great part removed. The contracting hands of the manipulator are, as it were, two more propelling hearts at the peripheral ends of the circulation, co-operating with the one at the centre; and the analogy will not suffer if we bear in mind that the size of one's heart is about as large as the shut hand, and the number of intermittent squeezes of massage that act most favorably on vessels, muscles, and nerves is about seventy-two per minute, which is about the ordinary pulse-rate."

Dropsy.—So far as their treatment by mechano-therapeutics is concerned, all dropsies, whether œdematous, ascitic, or articular, may be classed together. The experiments which have been detailed in the introductory portion of this article are so conclusive as to the possibility of inducing the absorption of effused fluids by manipulations that it follows, as a matter of necessity, that massage will prove an efficient agent for this purpose in pathological conditions. Two objects must be had in view: First, the removal of the fluid from its abnormal position in the tissues or cavities; and, secondly, its removal from the system, for if we simply procure its reabsorption into the circulation, the only effect will be to distend the vessels and render the blood hydræmic.

In ascites our principal attention will of course be directed to the abdomen. We should endeavor to stimulate the absorbents of that cavity to take up the fluids, and the organs to throw them off. Increased tone of the capillaries will diminish the serous exudation from their walls. Massage of the abdomen and liver and *percussion* and strong stroking over the kidneys are indicated. The results in ascites, however, are not as encouraging as in œdematous swelling of the extremities. Except in the last stages of renal and cardiac disease great relief can usually be obtained, and sometimes complete and permanent removal of the effusion. In this condition

we must use strong upward stroking, beginning at the distal end of the limb and working gradually upward, followed by kneading of the distended tissues, and terminating with abdominal massage and treatment of the kidneys as above suggested.

Schreiber remarks that "œdema of the lower extremities, caused by abdominal growths, can nearly always be greatly relieved, if not entirely removed, by the persistent manipulation (kneading and rubbing centripetally) performed once or twice a day for some time.

"The manipulation, which is very easily learned, should be performed with the patient lying or seated opposite the operator, with his limbs, previously oiled, raised upon a support. At first the rubbing should be carried on quite gently; later, the force can be gradually increased. It is well to begin at the toes, rubbing upward over the ankle and up the leg, either with one hand alone or with both hands placed side by side clasping the limb; or, the hand being half clenched, the inner side of the first and second joints of the first finger may be used. The rubbing and pressing should be maintained equably and forcibly for from five to fifteen minutes.

"In manipulating œdematous abdominal walls the motions should be made from above and outward, in a direction downward and inward toward the inguinal region, for the lymphatics of the anterior and lateral portions of the skin of the abdomen empty into the plexus of lymph-nodes lying within the pelvis and upon the internal iliac muscle. This plexus empties its contents into the superior lumbar nodes, and these again into the thoracic duct.

"Every year I see œdemas arising from the pressure of uterine fibroids greatly benefited by massage. They are all so alike that any detailed description of each is unnecessary."

Reibmayr records his experience that "in superficial œdema, either as a symptom of a general disease or the result of local obstructions to the circulation of the blood (congestive œdema), especially when occurring in the lower extremities, this treatment is peculiarly grateful, usually causing the accumulation to disappear, at least temporarily. Even in severe general affections a diminution may be effected, greatly to the satisfaction and relief of the sufferer. The secretion of urine increases correspondingly with the subsidence of the œdema. We can accomplish no more with diuretics, and neither so surely nor so innocently. If the œdema is the result of thrombosis of the veins of the lower extremities, massage must be employed with caution and the points of obstruction must by all means be avoided.

"Gussenbauer contributes a very interesting case of chronic œdema of the right upper extremity, which had resulted originally from an extensive adhesion among the sheaths of the tendons of the muscles of the forearm, and had harassed the patient for thirty years. He was

relieved of this troublesome affection by means of massage and forcible movements in the short space of three weeks."

"An increase in the quantity of urinary secretion under the influence of massage," says Murrell, "was noticed in a number of cases treated experimentally by Dr. Rubens-Hirschberg. It began during the first twenty-four hours, and increased steadily during the whole of the treatment, subsiding not at once, but gradually on its suspension. In the majority of cases it was unnoticed by the patient, but in one instance the patient complained that, contrary to his custom, he was disturbed at night and had to rise several times and pass water. In most cases the increase was gradual. In one case the patient, who habitually passed from 1500 to 1800 cc. in the twenty-four hours, voided under the influence of massage 2200, 2400, 2500, and 3000 cc. on successive days. On the termination of the treatment the diuresis was not arrested suddenly, but passed off little by little. The regularity with which this was observed in a number of cases points to the conclusion that masso-therapeutics is an agent of not inconsiderable value in increasing the urinary flow. Rubens-Hirschberg considers that it is a vaso-motor action, and that it is due to increased blood-pressure."

Dropsy of the joints and tendons will be more properly considered under the head of "Diseases of the Locomotor Apparatus."

Anæmia, Hydræmia, Leucocythæmia, Chlorosis, are all closely-allied perversions of the circulatory fluid dependent on defective assimilation. The applicability of massage and movements to these conditions is at once apparent. As they are, one or more of them, almost invariably associated with the condition which it is now fashionable to call neurasthenia, their further discussion will be continued under the head of "Diseases of the Nervous System."

Diseases of the Nervous System.—These conditions, for our purpose, may be broadly divided into *Painful Nervous Affections* and *Paralytic Nervous Affections*. Under the former head we of course class all the *neuralgias*, of whatever type or location. We limit the term to those conditions of chronic or constantly recurring pain which can be directly located in a nerve-trunk or a nerve-ganglion. Myalgia, commonly called muscular rheumatism, is probably simply a neuralgia of the terminal nerve-loops in muscles, but it is not usually classed among the neuralgias.

It may be said, with Reibmayr, as a general statement, that "massage is more fruitful of good results in the treatment of affections of the peripheral than of the deep-seated nerves. To these belong, above all, the neuralgias, which, distributed as they are superficially over the entire surface of the body, afford a most inviting field for massage. Such of them as are dependent upon either incurable lesions of the nerve-centres or the pressure or traction of tumors must of course be

excepted. It is in sciatica, of all the neuralgias, that massage has won its greatest reputation. Truly astonishing results have here been obtained, even when the affection has been of many years' standing and after every other conceivable means of relief has proved unsuccessful.

Neuralgia, as is well recognized, is usually a disease of debility. If, therefore, by means of general massage we can succeed in improving the tone of the whole system and increasing the vigor of the entire body, we shall in a large proportion of cases obtain a cure, even independently of local treatment.

In sciaticas of a rheumatic character induced by cold, the task, as a rule, is an extremely easy one. Strong stroking, alternated with percussion, along the course of the affected nerve, is usually all that is needed to cure the disease in a comparatively short time. Frequently, however, pathological alterations of the nerves or of their sheaths, or chronic inflammations, exudations, and so on in their immediate neighborhood, are the cause of the affection. Since such pathological changes may occur anywhere along the entire course of the nerve, it is a matter of the first importance to determine those positions in which alone local massage could induce absorption of the products of inflammation, and thus remove the suffering. It is a well-known fact that an exudation within the pelvis may be the cause of sciatica. If this proves to be within reach of the touch, pelvic massage will cure it. Such a case is contributed by Winiwarter. The sciatica was in this instance dependent upon a diffuse nodular tumor in the region of the left kidney, an exudation in the peri-nephral areolar tissue. The man had been bedridden for a number of years. After the employment of massage for two months he was completely cured and the tumor had vanished. When the sciatica is caused by tumors which are not susceptible of absorption, or by an inflammatory process so situated that it cannot be reached—as, for instance, deep in the lesser pelvis—massage must prove useless.

"In neuralgias resulting from anæmia, hysteria, and malaria," says Schreiber, "mechano-therapy can exert only favorable influences, for the passive and active movements employed increase the oxidizing powers of the blood, and consequently improve the nutrition of the brain and spinal cord and of the organism generally." This writer devotes more than one-third of the therapeutic portion of his treatise to the details of his treatment of these affections. He advises that in extreme cases of long continuance passive movements be first employed, then active movements, and finally massage. In this way the sensitiveness of the nerve-trunks is gradually diminished, and direct pressure upon them is better tolerated. Taking a supposed case of sciatica, in which it is almost impossible for the patient to lift the foot from the

floor when standing, he sketches the progressive treatment for a period of thirty-two days, day by day. This is very briefly as follows:

1st Day.—Thigh flexion, in the standing position, entirely or nearly passive; it is encouraging the patient to make the effort, and so educates his will, which is usually nearly inert. This movement, which is designed to put the glutei muscles on the stretch, is to be repeated ten times. It is well to have some object, as a bar, the height of which can be graduated, to which the foot should be elevated, the height being increased from day to day. It may be said here that in this as in every effort to restore lost power of movement, even when the result of paralyzing nerve-lesions or cerebral paralyses, it is of great importance to treat the mind as well as the muscles and nerves. Much may be accomplished by encouraging the patient to make the attempt to move a part, and at the same time, without his knowledge, aiding him in the effort. The will is thus coaxed back into its forgotten channels.

The patient then lies on the back on a firm couch or bench, and the attendant flexes the thigh upon the pelvis. This should be done slowly and cautiously, in order not to discourage the patient at the outset by giving him excessive pain. The angle of forced flexion should not exceed forty-five degrees, and the limb should be maintained in that position but for a moment. After a short interval of rest this movement should be repeated, and so on for ten times. Let it here be noted that all duplicated movements should be made very slowly, the patient being compelled to fix his attention on them. It is well, especially if they cause pain, to make him keep the count himself, as it stimulates his pride to reach the requisite number. The principle of alternate rest and exercise is also an important one in passive exercise and massage as well as in active movements. It is well for the patient to lie flat upon the back for two or three minutes several times during a séance.

The passive flexions having been concluded and the patient having rested after them, a very gentle kneading, using only the finger-tips, may be given over the muscles of the thigh and the glutei, as high as the crest of the ilium. It must be expected that considerable pain will follow this procedure, and continue for a period varying from half an hour to two or three hours. It will not be strange, either, if the nocturnal pains should be aggravated for a number of nights. It is well to forewarn patients and their friends of this probable result.

2d Day.—The attempt to flex the thigh actively will be repeated, the patient standing, and he will also be instructed to abduct and adduct the thigh. If necessary he may support himself by taking hold of the horizontal bar. These movements should then be performed passively. He should then lie upon the back, and the same movements

be performed passively. The kneading follows, somewhat more vigorously than on the first day.

The procedures thus far described will now form a part of the routine of each day's treatment.

3d Day.—Kneading with the knuckles is added.

4th Day.—The patient is now to stand on the affected leg and raise the other foot, first to the top of the bar, and then over it. Deeper kneading and percussion may be used.

5th Day.—Every few days the bar should be raised one peg. Kneeling on either knee alternately is now to be used. Each day the passive flexion of the thigh is to be made with greater force, the knee being brought nearer the chest. This movement is in reality a *nerve-stretching without the use of the knife*, and much depends upon its conscientious and faithful performance on the part of the operator, and upon the endurance of the necessary resulting pain on the part of the patient.

6th Day.—First kneeling with the knee of the affected side, then with the other knee. Muscle-chopping will to-day be added to the manipulatory processes. Care must be taken not to use too much force at first, as the procedure is a powerful one and may produce ecchymoses. Schreiber treats these as necessary results and of trifling consequence, indeed even perhaps beneficial. But as he himself admits that it is well to avoid subsequent manipulations over such extravasations until they have been absorbed, it is evident that they interfere with the treatment to that extent. The effect upon the patient's mind, and especially upon that of her friends in the case of a delicate woman, in whom such appearances are most apt to occur, cannot but be painful.

In performing this manipulation the thigh should be slightly abducted and the knee flexed. To reach the inner side of the thigh the physician should stand on the affected side and begin at the knee. The buttocks and the anterior and posterior aspects of the limb may be reached from either side. Bony prominences must be dealt with very gently. This should be the last severe manipulation of the day, but may be followed by a gentle stroking to allay nervous irritation.

7th Day.—The rotators may now be brought into play, both passively and actively. Standing erect, with the heels close together, the patient should be instructed to turn his toes out. The heels are then to be separated, and the toes must be turned in. In both of these movements the knees must be kept straight.

Passive external rotation, usually an extremely painful movement, is conveniently performed by placing the patient in the sitting posture, with the ankle of the affected leg resting across the opposite knee. The operator then makes pressure directly downward on the knee of the lame leg. This must be done with great caution.

8th Day.—The patient may now be made to take a few steps as in

proper walking—*i. e.* bearing his weight equally alternately on each leg, with the body slightly inclined forward. The physician, taking hold of both of his patient's hands, draws him toward himself, thus compelling him to take a step. Schreiber has adopted an ingenious expedient to compel the patient to lift the foot of the affected side instead of dragging it. He places a series of small beams of wood on the floor at even distances, like the ties of a railroad-track, and then, taking the patient's hands, walks backward, drawing the patient after him, and at the same time supporting and steadying him. Curtseying and straddling are now added to the movements.

9th Day.—Sitting and rising from the chair without aid from the arms. Maximum passive abduction of the thighs, the legs hanging on either side of the bench. Very efficacious, but also very painful.

10th Day.—Running over the cross-ties, instead of walking. Rapid passive abduction and adduction of thighs. After forced flexion of the thigh on the chest it is to be extended rapidly and violently.

11th Day.—Rest.

12th Day.—Stepping up on to the horizontal bar, down and over with both feet. Strong kneading of the flexed thigh.

13th to 20th Day.—Repetition of all these movements in various combinations with massage as usual.

21st Day.—Rest.

22d Day.—Flexion of thigh, with knee extended. Crossing the legs, first in the lying, then in the sitting, position. This must be at first passive.

23d Day.—Leaping, first, down from the horizontal bar; secondly, leaping upward and performing abduction and adduction while doing so; thirdly, jumping over the bar. In all these movements the physician holds the patient's hands, supporting and at the same time instructing him how to perform them thoroughly and precisely.

24th to 30th Day.—Repetition and combination of all previous movements and manipulations.

31st Day.—Rest.

32d Day.—The patient should now be able to perform all ordinary movements of walking, sitting, going up and down stairs, etc., with comparative ease. Curtseying and turning while lying are now to be especially practised.

If the case has progressed favorably up to this point, it may be sufficient to have a séance only every other day, and in this way the intervals may be gradually lengthened.

The duration of the treatment will depend, of course, on the previous length of the illness, the extent of the disease, the age, temperament, idiosyncrasies, and general nutrition of the patient, and the perseverance and skill of the operator.

The following is an ordinary prescription for sciatica:

1. Half lying, thigh rotation.
2. Face lying, nerve-pressing and percussion (sciatic nerve).
3. High-ride sitting, trunk rotation.
4. Half lying, knee-upward pulling.
5. Inclined thigh support standing, back extension.
6. High opposite standing, leg inward pressure.
7. See No. 2.
8. Half lying, leg extension.
9. Opposite standing, sacrum percussion.
10. Half lying, foot flexion and extension.
11. Span standing, hip twisting.

(*Explanatory Note.*—High ride sitting is sitting astride on a high stool or narrow bench, in order to fix the pelvis.

Half lying is reclining at an angle of about 45°.

Opposite standing is leaning forward and resting with the elbows or forearms on some object at about the level of the nipple.)

The physician who has followed this detailed account of daily treatment carefully, and appreciated its rationale, will not need to have a similar description of the treatment of neuralgia affecting other main trunks, such as, for instance, cervico-brachial and cervico-occipital neuralgia. Studying the relations of the nerves and muscles of the part, the limitations of motion and impairment of will, he will in the same way direct his efforts toward diminishing nervous sensibility and improving the nutrition of the region by massage and reconstructing the motor capacity by movements.

The value of massage in relieving that form of neuralgia of the head known as *hemicrania* or *migraine* is so great as to entitle this subject to special reference. Congestive headaches also are greatly benefited, especially by massage of the neck.

We have seen that neck-massage, by accelerating the venous current in the numerous superficial veins of this region, may act advantageously upon hyperæmias in the peripheral distribution of the carotid arteries. Its operation is like that of a copious bloodletting, but without the injurious results of the latter. We may therefore bring it into requisition in all *congestions of the brain and its membranes*, whether resulting from an increased tendency of the blood to the vessels of the brain—rush of blood to the head, active hyperæmia; or a retardation of the escape of the blood from the brain—passive congestion. In all such cases we can succeed, in a comparatively brief space of time, in diminishing the blood-pressure within the cavity of the cranium by massage of the neck, and its use is therefore indicated as a preliminary to the employment of the slower derivative agents, such as drastic purgatives and fomentations of the extremities or of the trunk. In

consequence of the rapidity with which it acts it should always be instantly resorted to in sunstroke. The readiness with which it can be applied makes a knowledge of it especially important for the military surgeon, under whose care such accidents most frequently fall.

Gerst urges its employment in concussion of the brain, even when extravasation of blood has taken place within the cavity of the cranium. The observations of Mills, Stoddard, Weiss, and Nonhebel indicate that severe headache and hemicrania often yield to it with celerity.

It is indicated in full-blooded patients, when it can be perceived that the hemicrania is the result of a reflex or vaso-motor dilatation of a branch of the carotid.

In the hemicrania of anæmic, nervous patients it does no good. In these massage must be applied to the scalp, especially over the forehead and temples.

Mills observes: "In some neuralgias and for the neuralgic constitution its usefulness has been established by a number of observers. Both stroking and friction are beneficial in nervous headaches. I have frequently seen the headache of a nervous woman relieved by gently stroking the forehead, while energetic frictions or shampooing of the entire head are sometimes more efficacious with men."

A valuable contribution, entitled the *Treatment of Hemicrania by Massage*, has been made by Norström of Paris. The ground which he takes is that the great majority of the varieties of headache to which this general name has been given are neuralgias of *muscular origin*, accompanied by centres of induration, and often by sensitiveness on pressure along the nucha. The indurations he considers to be the result of chronic inflammatory processes. As he well observes: "To say that this affection is a neurosis, and to act accordingly, is to be satisfied with very little." He claims that the removal of these inflammatory deposits by massage is almost invariably followed by the complete cure of the neuralgia, and that just in proportion as the process of absorption takes place is the degree of improvement. The seat of these muscular lesions, associated with the hemicrania, he has found to be as follows in 32 cases: Superior insertion of the muscles of the posterior cervical region, 14 instances; body and inferior insertion of the same muscles, 19 instances; muscles of the antero-lateral regions of the neck and those of the shoulder, 9 instances; integuments of the cranium, 2 instances; temporal muscles, 3 instances; ganglia of the great sympathetic, 2 instances.

On this subject Vretlind says: "I believe that in many instances hemicrania, considered to be rheumatic or nervous in its character, depends upon or is in close relation with chronic myositis. This myositis does not affect exclusively the muscles of the head; it may

extend to those of the neck, nucha, or even of the shoulders. The connection is usually not suspected, because the muscles are not examined. If I may trust my own experience, the muscles in question are often the seat of nuclei of induration of greater or less firmness. The most important in this connection are the trapezii, especially at their points of insertion into the nucha and the scapula; then the splenius; and finally the scaleni. This condition may exist, and yet the individual not be conscious of pain in the course of the muscle or experience the slightest difficulty in making active movements. On examination, decided tenderness is usually found at the affected points on making somewhat firm pressure, or, if possible, squeezing the muscle between the finger or thumb.

"In order to accomplish this the patient should raise the arm corresponding to the affected side, supporting it upon some object, such as the back of a chair, which is higher than the axilla, and allow it to rest in such a way that the trapezius shall be completely relaxed. In this position its superior border and its acromial portion may be taken between the fingers. Very often there will thus be found, in passing from above downward from the nucha to the scapula, a swollen point of induration which is more sensitive to pressure than the rest of the muscle, and upon such pressure the patient experiences radiating pains which may extend as far as the region about the eye."

Similar observations have been made in Mezger's clinic.

Dr. Walter Johnson says: "If any surgeon or physician, who has not hitherto had his attention directed to this point, will manipulate the flesh of his patients, he will be surprised to find in how many cases he will detect thickenings, hardenings, and swellings in various parts. He will find the necks of nearly all his patients who have suffered for any length of time from head affections swollen and indurated, with most probably enlarged absorbent glands in the neighborhood. The neck and shoulders will frequently be tender to the touch, and the muscular and other fibres will be dry and will crackle perhaps on pressure."

The relation between these foci of induration and the accesses of neuralgic pain Norström regards as that of cause rather than of effect. His treatment is, therefore, massage applied directly to them with a view to procuring their absorption; and this he considers to be only a question of time and perseverance on the part of both operator and patient.

Neurasthenia is the Greek for "nervous prostration." The word was coined by Beard of New York, but whether the addition to our vocabulary has enriched it may well be questioned. This condition of lowered vitality, depressed innervation, enfeebled digestion, impaired assimilation, unbalanced circulation, impoverished blood, superficial

hyperæsthesia, and emotional irritability is usually found among women, and to a greater extent among the women of America than those of any other country.

With its causes we are not concerned in this work. It should probably be located not in the cerebrum nor in the spinal cord, but in the nerve-centres of organic or vegetative life—the great sympathetic, the great solar plexus, the pneumogastric, and their associated ganglia. Let it be borne in mind, however, that nerves, if supplied with good, pure, nourishing food and allowed proper periods of rest, rarely give trouble. They are the most long-suffering of all the bodily organs, and do not cry out or strike work unless starved or grossly imposed upon. Faulty nutrition is generally at the bottom of their grievances and apparent misbehavior. It is not difficult to understand, therefore, that any mode of treatment which will improve the general nutrition of the body and furnish an abundant supply of pure blood will strike at the foundation of all functional nervous perturbations and depressions. This, massage and movements, combined with proper attention to diet and strict enforcement of hygienic precautions in regard to clothing and ventilation, and if necessary seclusion and rest, will accomplish.

The appropriate treatment of this large, increasing, and extremely troublesome class of cases was first sketched by Charles F. Taylor of New York in an article entitled *Carnomania*. But it was not until the publication of S. Weir Mitchell's valuable essay, *Fat and Blood, and How to Make them*, that the attention of the profession was strongly attracted to the importance of massage and movements in the management of nervous exhaustion.

For the purpose of illustrating the mode of their application in this affection let us suppose a somewhat extreme case. The patient is a woman, usually unmarried, of nervous temperament and active brain, aged between twenty and thirty years. She may have enjoyed fairly good health up to the age of puberty, when her manifestations of nervous disturbance became somewhat more marked. Owing to excessive brain-work, as in preparing for graduation at school, or, still worse, "college," or unusual and protracted physical effort or long-continued anxiety, such as accompanies nursing a near relative through a long illness, she has had a "breakdown" and probably a run of nervous fever. Since this attack she has been practically an invalid, sometimes better and sometimes worse, but on the whole quite unfit for the discharge of the ordinary duties of life. She has had an almost constant backache and frequent attacks of gastralgia. Vomiting has not been uncommon. Locomotion has been painful, and has consequently been given up, until she has become bedridden. She has experienced temporary relief from blisters, issues, and possibly a seton over the spine.

Menstruation may or not have been painful, but all her symptoms have been aggravated at that time. It is very probable that she may be suffering from amenorrhœa of a year's duration or longer. Hysterical convulsions, hystero-epilepsy, even hysterical mania, may have developed. If indigestion and vomiting have been marked features of the case, she is much emaciated; if not, she may appear to be in good flesh, but her muscles will be flabby. There may be tonic spasms of some of the muscles, and even contracture to an extreme degree, the heels being drawn up until they touch the buttocks and the knees close to the chest. Spasmodic twitchings are also frequently present. The countenance is pale and the lips bloodless. Hyperæsthesia and perversions of sensation, especially on the lower extremities, are almost constantly present, often to such an extent that the weight of the bed-clothes cannot be borne. Constipation is obstinate. A narcotic or hypnotic habit of some kind has probably been formed—morphine, chloral, Hoffmann's anodyne, or some other hypnotic, together with an alcoholic stimulant, being taken in inordinate quantities. The whole range of tonic and purgative medication has of course been gone through. The eyes are intolerant of light and the ears of sound, the skin of contact and the stomach of food.

It will doubtless be objected that this picture, like the combination-character photograph, confounds several morbid individualities—that we have here described not simply neurasthenia, but hysteria, hystero-epilepsy, catalepsy, dyspepsia, spinal irritation, and what not. It is precisely because neurasthenia is simply the vestibule to any or all of these conditions that this conglomerate view has been presented. In many instances, if taken in time, these extreme manifestations will never be reached. But it is quite possible for any neglected or improperly managed case of this affection to develop any or all of the symptoms and results above described.

The immense catalogue of symptoms presented by cases of neurasthenia certainly justifies the assertion that this condition is simply a loose term made to cover all conditions of nervous disturbance, accompanied by debility, which we are as yet unable to trace to organic alteration of the nerve-tissue. Idiosyncrasy of course shapes the type which this condition will assume in the individual. Hence the physician must study his cases carefully, not binding them down to one iron-clad routine, and must treat the morale as well as the physique. It is with the latter object in view that he will sometimes recommend seclusion among strangers. A will which has become obstinate in one direction and *nil* in another must be restored to a healthful condition by the influence of a stronger will over it. Such a period of complete separation for a time from her own family, although they as well as the patient will strongly resist it, will enable them to burst

the bonds of a tyranny which destroys the happiness of the home and not unfrequently ruins the health of those nearest and dearest to her.

What shall be the mechanical treatment of such a case as that described? It is well to begin with the extremities which are least sensitive, and these are usually the upper. Passive flexion and extension of the last phalanges should first be made with upward stroking of the whole finger. Then the middle, and finally the proximal, phalanges should be manipulated in the same way. This will be sufficient for the first day. On the second day the flexion and extension will be carried to the metacarpal articulations, and on the third to the wrists. A rotation of each finger and of the wrist will be added. On the fourth the elbow-joint will be reached, and the pronation and supination of the forearm will be made. On the fifth the shoulder will come into play, with movements forward and backward, abduction and adduction and rotation. On each day all the movements of the preceding day are of course repeated.

On the sixth day kneading of the arm and hand will be begun, gently at first and with gradually increasing vigor. By this time there will be noticed a slight improvement in the capillary circulation of the fingers, less blueness in the nails, and less rigidity of the joints. The patient may now, on the seventh day, be instructed to resist slightly the hand of the manipulator in the different movements, and also to make the same movements herself against slight resistance on his part. In urging her to make a specific movement he should precede her effort by carrying the part which she is to move into the extreme opposite direction. This will put the muscle which is about to be used on the stretch, and the slight stimulus thus communicated to it will enable it to contract with more readiness and force. In the same way he should, as he feels that her effort is ceasing, carry on the movement himself to its completion, thus affording the stimulus for the return movement. Whenever he orders a movement to be made he should insist on its completion, even if he must make it entirely himself. Nothing subjects the will of a patient to the physician more quickly than enforced muscular movement. It produces a sense of powerlessness which effectually disarms resistance.

The second week will begin with movements of the toes, proceeded with in precisely the same manner as those of the fingers, and, day by day, additional joints of the lower extremities will be added to those already manipulated, all the hand and arm movements being sedulously kept up. This will complete the second week. We have now made use of passive, active, and duplicated movements of both extremities, compelling both eccentric and concentric contractions of every muscle; we have aided the flow of the blood and lymph toward the heart by our

upward strokings, and have effectually emptied the muscular capillaries and invited fresh blood into them, and stimulated the interchange of elements in their cells by our kneading. The whole process of circulation and tissue-metamorphosis has received an immense impulse, with no corresponding expenditure of nerve-force on the part of the patient. The time has now come to provide more effectually for the removal of the effete material which the blood is becoming charged with, although the flexion and extension of the thighs, acting on the psoas and iliacus muscles and those of the abdominal wall, have not been without a stimulating influence on the pelvic viscera.

The third week opens with a strong respiratory movement, the hands being held above the head and drawn upward, while the patient is urged to inspire deeply, which she finds little difficulty in doing in this position. She then draws her hands down to her sides against the resistance of the operator. The effect of this movement is to pump up the blood into the lungs, heart, and abdominal vessels. We follow it immediately with abdominal massage, using the surface stroking for reflex purpose somewhat sparingly, and relying principally on kneading over the course of the colon. To the kneading of the extremities are now added chopping and fulling. These movements will be continued during the third week. By the end of this week the spinal and cerebral excitability should have been somewhat reduced by the calmative influence of the purer and more abundant nourishment which those centres are receiving, and we may safely proceed to manipulate the spinal region from the base of the brain down to the sacrum. The manipulations will begin with stroking downward and outward from the spine in either direction, covering the entire back. These will be followed by kneading, carefully noting tender points and working around and away from, rather than directly over, them. Chopping and whipping of these surfaces will follow.

Movements of the trunk, flexion and extension, sideward bending and rotation, will now be in order. These will be continued to the end of the fourth week.

With the opening of the fifth week we may venture on clapping over the back and liver and percussion of the spine, the patient being carefully watched during the latter procedure to see that faintness does not result, and the previous caution being observed with regard to tender points.

At the commencement of the sixth week neck-kneading and head-movements, flexion and extension of the cervical spine, side bendings and rotation, and massage of the scalp will be in order. Special attention must be given to the muscles of the neck, enlarged glands, and exudative deposits, muscular adhesions being carefully kneaded, dispersed, and broken up in cases where there has been much headache.

Downward stroking of the neck must be used with caution in anæmic cases.

The following is a prescription for general massage suitable for any case of debility, impaired nutrition, neurasthenia of moderate grade, or similar condition of the system, designed to be tonic and alterative:

1. Half lying, foot rotation, with active flexion and extension.
2. Half lying, leg kneading, clapping, fulling, and stroking.
3. Half lying, thigh rotation, followed by leg extension.
4. Yard sitting, arm kneading, chopping, clapping, fulling, and stroking.
5. Passive arm rotation, with active flexion and extension.
6. Hook-half lying, abdomen kneading, vibration, and colon stroking.
7. Opposite inclined standing, sacrum percussion.
8. Opposite inclined standing, longitudinal and transverse back clapping and stroking.
9. Standing, active arm rotation, with deep breathing.

(*Note.*—"Yard" signifies that the arms are stretched out laterally, horizontally.)

Paralytic Nervous Affections.—It is taken for granted that in other parts of this work the differential diagnosis of the various paralyzing lesions of the brain and spinal cord and of the peripheral nerves will be detailed. It is sufficient for the purpose of this article to say that, in a broad way, those palsies which are associated with muscular degeneration, whether atrophic, pseudo-hypertrophic, or fatty, are most amenable to this method of treatment, and that in these affections we rely principally on movements. Acute central disturbances of an inflammatory character always preclude their employment. But muscular spasm is not necessarily a contraindication. In functional, rheumatic, and hysterical paralyses it is especially indicated. Schreiber says that the value of the Swedish methods is nowhere more strikingly illustrated than in the treatment of palsies. Ordinarily, when active motion has been prescribed, all attempts to give particular exercise to the paretic muscles are rendered nugatory by the simultaneous action of the antagonizers, which easily overpower the weaker muscles. It is an essential feature of the Swedish movement cure that it aims to place at rest the entire muscular system, save and except only the particular set of muscles which it is desired to call into activity, and this whether the movements are given directly by the physician or through the medium of machines.

In the essential paralysis of infancy truly wonderful results are attainable. The treatment should be entered upon the moment the acute inflammatory symptoms, if such existed, have disappeared, and continued daily in the face of seeming absolute ineffectiveness for

weeks and even months. Cases in which no improvement can be detected for long periods often suddenly begin to improve, and progress with great rapidity. The idea which was suggested in speaking of sciatica, of giving the patient a definite object to accomplish, and in this way to stimulate the brain as well as the muscle, acting on the centre as well as on the periphery, is equally applicable here. The other thought, too, of indulging in the pious fraud of aiding the patient, especially if a child, in accomplishing the movement which he is instructed to make, and leading him to think that he has been successful in his effort, will prove a useful one in these cases.

Gowers strongly urges the use of massage in acute atrophic paralysis, whether in the child or the adult. He says: "Another method which should be employed is systematic rubbing of the limbs. This stimulates the circulation, which is always defective, as the blue-cold surface shows. It no doubt also increases the motion of the fluids outside the vessels, and so probably increases the interchange of material. *The muscles should be daily rubbed and kneaded and gently pinched.* The rubbing should be especially upward, so as to expedite the flow of the blood in the veins."

Pseudo-hypertrophic Muscular Paralysis.—In this mysterious affection, in which loss of power is coincident with gradual apparent increase in the volume of the weakening muscle, as well as in its firmness, systematic movements are of the greatest benefit, and no other means offers the slightest prospect of retardation or benefit. The author just quoted remarks: "Muscular exercise does seem to have some influence in retarding the failure of power. It may perhaps cause some growth or increased capacity for contraction in the muscular fibres that have not yet suffered. It is possible, also, that it may, to some extent, divert the trophic energy from the interstitial tissue, since cessation of muscular exercise is certainly followed by quicker failure of strength. Hence it is desirable that the patient should carry out carefully-planned gymnastic exercises so arranged as to call into action the muscles that most need help. These, thoroughly persevered in, have seemed more than any other means to retard the disease. But they have not in any case arrested it. Rubbing and massage are useful, combined with passive movements, in lessening the tendency to muscular contraction and consequent deformities."

Locomotor Ataxia.—This intractable, if not incurable, affection is often greatly retarded in its progress by mechanical methods. Weir Mitchell says: "It is many years since I first saw in this city general massage used by a charlatan in a case of progressive paralysis. The temporary results he obtained were so remarkable that I began soon after to employ it in locomotor ataxia, in which it sometimes proved of signal value, as in other forms of spinal and local disease." It is

in this affection that machine vibrations and stretching of the spinal cord by means of suspension by the head produce astonishingly good results.

Lateral Scleroses, in common with all spinal affections which are characterized by greatly increased irritability and exaggeration of the reflexes, are not benefited by this system. The paralytic conditions following certain acute infectious diseases, such as diphtheria, are often greatly improved under it.

Spasmodic Nervous Affections.—Chorea Sancti Viti, even its graver forms, rarely fails to improve under a judicious course of movement and massage.

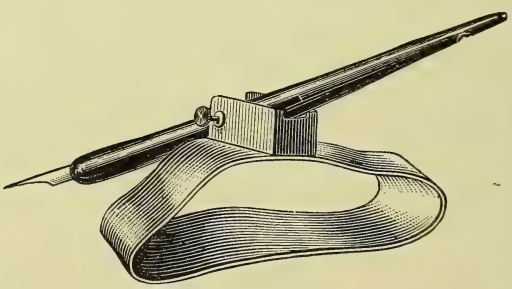
In the year 1854, Dr. Blache presented a memoir to the Academy of Medicine in Paris on the "Results obtained by the Use of Gymnastics and Massage in Chorea," on which Bouvier submitted a very favorable report to the Academy in the year 1855. The manner in which he adapted this method to the treatment of chorea is as follows: At the outset, when the muscular contractions are so powerful that the limbs and trunk are thrown about in the wildest manner, the patient should be placed upon a mattress and held as immovable as possible by three or four attendants for from ten to fifteen minutes. The masseur then begins to perform light stroking with the full palm of the hand over both upper and lower extremities, and also over the chest, gradually increasing the pressure. The patient is then turned upon the face, and the same stroking is given upon the back, especially over the neck and upon the strong muscular masses on either side of the spinal column. Such an application should continue about an hour, and should be repeated in from three to four days. After each treatment the irregular muscular contractions become less violent, and the patient makes it understood by his gestures that he feels more comfortable. Sleep, which has been completely interrupted during the continuance of the most violent contractions, is gradually re-established and speech begins to return. For several subsequent days the light stroking and friction must be persisted in, and the masseur may then begin very regular, rhythmical passive movements. These are to be made with especial care through three principal joints of both extremities. In making these movements there is naturally a not inconsiderable tension of the antagonistic muscles to be overcome, but this gradually yields, and the child is soon in a position to supplement the communicated movements by active muscular contractions. After every sitting the pain which was at first experienced in the muscles from pressure or tension diminishes. When these passive exercises have been continued from eight to ten days the will has so far resumed its mastery over the muscles that the child is able to eat and take a few steps alone, although very totteringly. Active gymnastic exercises are now superadded. These must be the simplest physiological movements of the limbs and trunk,

such as will but slightly tax either the attention or the will. It is a great assistance to have the movements made in front of the patient for him to see, and at the same time to have singing or instrumental music, with a strongly accentuated measure which coincides with the time of the movements. The rhythm and the mimicry are both aids to the control of the will over the muscles. Under the influence of these exercises the child's disposition improves. It becomes more cheerful, companionable, and docile; its appetite is better, its strength increases, and the emaciated, anxious face grows fresh and rosy. By the end of ten or twelve days the improvement usually comes to a standstill, over which point the patient must be helped by persuasion and encouragement. It soon begins afresh, and a radical cure quickly ensues. With the cessation of the irregular muscular contractions the chlorotic condition, which appears to form the basis on which the chorea is founded, as well as the palpitations of the heart and the arterial murmurs, also vanishes.

The cures of chorea obtained in this way appear to be more permanent than those effected by any other course of treatment. Dr. Blache assures us that among the 108 children thus treated up to the time of his report not a single relapse had occurred—a remarkable contrast to the statement of Sydenham, that chorea usually returns in the autumn of the following year. Very recently this method has been recommended by Mills, Goodhart, James, John Phillips, and Busch.

Writers' Cramp.—Massage has recently acquired an especial significance in the treatment of certain forms of cramp which depend

Fig. 120.

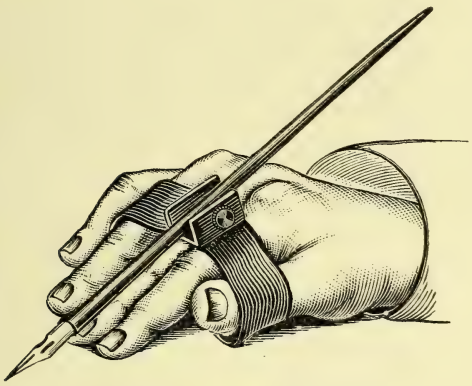


The Nussbaum Bracelet for Writers' Cramp.

principally upon a disturbance of the peripheral nervous system, often as a consequence of undue irritation and over-tension of the affected nerves. Such are twitchings in the regions supplied by the facial nerve and the accessorius of Willis, writers', piano-players' violin-players', telegraphers', and knitters' cramp—usually idiopathic, tonic contractions of certain distinct groups of muscles. The treatment of these forms of cramp consists in strong stroking, percussion, and kneading of the

affected muscles, combined with systematic exercise, both of them and of their antagonists. The little apparatus known as Nussbaum's

FIG. 121.



The Nussbaum Bracelet, as used.

bracelet is not simply a pen-holder, but a form of exercise. Its object is to compel the use of the extensors and adductors of the fingers, and in that way afford a rest to the abductors and flexors, which have been overtaxed.

A German writing-master named Wolff has achieved an immense success in the treatment of this class of cases. He depends much upon active movements of the fingers separately. To accomplish this he fixes the fingers which he desires to keep at rest with rubber bands. A séance lasts about half an hour, and must be repeated once or twice every day.

Diseases of the Locomotor Apparatus.—MYALGIA—or, as it is oftener called, MUSCULAR RHEUMATISM—is probably a neuralgia of the ultimate nerve-fibrils in a muscle. The rapidity of its onset forbids the belief that it is due to an inflammatory process. It is accompanied with stiffness and pain on motion. It is always present in the form of neurasthenia known as spinal irritation, producing points of tenderness which are considered characteristic of that affection. Stiff neck is a familiar instance of it; lumbago is another. Massage, principally in the form of circular kneading and stroking, almost invariably affords prompt relief in the latter distressing and disabling affection.

In the rigid conditions of joints following rheumatism and rheumatic gout this system, in connection with mineral waters and baths, constitutes almost our sole resource. The results which can be achieved by long and patient persistence in its employment are truly remarkable.

Effusions in the joints and along the course of tendons (tendo-vaginitis) are greatly benefited, and often entirely removed, by combined friction and upward stroking.

In the treatment of all joint affections, and especially of those resulting from injury, what is termed by Reibmayer "introductory massage" is of the first importance. Before the stiff or painful joint is touched, massage of the limb or body above the joint should be instituted, consisting of strong kneading and centripetal stroking. In this way the capillaries and absorbents of the part on the cardiac side are put into a condition of readiness to take up and dispose of the effused material.

SPRAINS.—No traumatic conditions about joints lead to more deplorable results, and none are more amenable to rational treatment, than sprains. A sprain is defined by Busch in Ziemssen's *Handbook of General Therapeutics* as the forced excursion of a joint beyond its normal limit of movement. In consequence, the articular surfaces on the side toward which movement takes place are pressed together, and a point of contact is formed which serves as the fulcrum for the lever which forces apart the opposite portions of the articular surfaces. In consequence of the gap caused by this separation a vacuum tends to form within the joint, but this is prevented by the soft periarticular tissues being forced in by atmospheric pressure. At the same time, the tendons and ligaments are violently extended and may be even slightly torn. The moment the force is removed the articular surfaces instantly approximate again, occasionally including folds of synovial membrane between them, or displacing the interarticular cartilages when these exist. The pain caused by the sprain is the natural result of these mechanical disturbances. It occasionally happens that the sheaths of the tendons are ruptured, and the tendons themselves sprung out of place and over some bony prominence.

Having thus laid down the exact nature of the sprain, he divides the object to be achieved by mechanical means into two divisions, founded on pathologico-anatomical considerations.

1. *Restoration to their Normal Relations of all the Component Parts of the Joint.*—He cites here the practice of one of the older French surgeons, Ravaton, who, whenever called upon to treat a recent sprain if swelling had not yet taken place, had the joint forcibly put on the stretch by two strong men pulling in opposite directions, while he clasped his hands about it, locking his fingers and making firm pressure on every side in order to force into place any bones that might have become dislocated. Then, after replacing such tendons as had slipped from their grooves, he applied a bandage. This restitution of all the parts to their normal environment is especially important in joints possessed of semilunar cartilages, for they are particularly liable to be displaced by sprains, and to remain caught between the articular ends of the bone—a condition called "internal derangement" by English authors.

2. *Removal of the Spastic Muscular Contractions.*—After a muscle has been put violently upon the stretch it reacts, and a state of tonic

spasm ensues, which is not only painful in itself, but doubly so in these cases on account of the forcing together of the articular surfaces which it causes. This spasm may, however, be quickly dissipated by gently rubbing the muscle.

In treating a sprain of the ankle we begin with gentle centripetal rubbing, using first the finger-tips, then the whole surface of both hands, commencing at the toes and gradually proceeding upward as far as the painful spasm reaches. As the pain diminishes more and more force may be employed, and when the contraction has so far relaxed as to leave the joint movable, gentle flexion and extension of the foot should be performed. A flannel roller carried above the ankle should then be applied. After the second or third sitting the movements of the ankle-joint will generally be quite free and almost painless. The patient may then be allowed to walk a few steps. Should this not be followed by an increase of pain, the amount of exercise may be cautiously increased until full use is re-established, watching closely all the time for the first signs of any inflammatory swelling.

Graham points out that the sooner the treatment is commenced the shorter is its duration. The advantages resulting from massage are speedy relief of the pain and swelling and earlier and more perfect use of the limb and joint. Bergmann treated successfully by massage no less than one hundred and forty-five cases of recent traumatic joint affections, including contusions, sprains, and synovitis with effusion. Seventy cases affecting the ankle-joint recovered on an average in six days, whilst thirty-eight cases of old sprains required twenty-two days each. It was found that after a plaster-of-Paris dressing had been applied even for a very short time the duration of the treatment was much prolonged. Nélaton, Sée, Demarquay, Labbe, Duplay, and others speak highly of the value of massage in affections of the ankle-joint. Dr. Roux of Lausanne says that it acts almost like magic in cases of synovitis, whether of rheumatic origin or resulting from an injury. In the Prussian army, where treatment by massage is in certain cases obligatory, it is found that the average duration of the disability from sprains not treated by massage is twenty-seven days, whilst when masso-therapy is resorted to it is only nine days. These results, based on the observation of a large number of cases, are very striking.

Murrell calls attention to an interesting chapter on massage in an excellent work on *Sprains* by Mr. Mansell Moullin. The author, after describing the methods of procedure, points out that the best proof of the power possessed by massage over absorption and circulation is shown by the ease with which swelling and tension can be made to disappear from sprained joints. "In recent cases," he says, "the greatest care is required, and nothing is so likely to increase the mischief as

rough handling of the part; but when it is carried out quietly and gently by one who has had some experience, it is very difficult to find anything that acts in so perfect a manner. The whole limb perhaps is swollen, the joint distended with blood, the skin shining and tense, much too hot to the touch, and exquisitely tender, but all this vanishes as if by magic. The tension disappears as the fluid is carried off, the pain is relieved, the temperature falls, the natural outline begins to appear once more, extravasated blood is broken up, the débris dispersed, and adhesions between the torn and bruised surfaces effectually prevented. Sometimes even tendons which have been turned almost out of their grooves by the accumulation of fluid in their sheaths can in this way be restored to their positions without further assistance. Such results as these cannot of course be obtained in every case of recent sprain, and even when the treatment is successful in relieving the pain and getting rid of the swelling, it must always be remembered that time is needed for the repair of structures that have been torn. I am convinced, however, that especially when the stress of the injury has fallen on the muscles, and when the laceration is not too great, this plan may be adopted not only with the greatest safety, but with an infinitely better prospect of speedy recovery than under the old-established method of bandaging and rest." Speaking of more chronic cases, where the effusion is denser and firmer, and where, owing to the long-continued distension, the tissues have lost their tone and become sodden and œdematous, the author recommends that massage should be applied with greater freedom. "The solid part of the effusion is broken up and disintegrated by the pressure, so that it is driven into the absorbents and carried away by the increased force of the stream; the chronic congestion is dispersed, the blood circulates more freely, the tone of the part returns, and the lifeless, helpless look disappears day by day. The improvement is often surprising in its rapidity. A joint that has remained for weeks cold and inactive, the seat of a constant wearing pain, and quite incapable of performing its proper movements, in a very few sittings begins to recover its flexibility, loses the pain, and allows itself to be handled, and passive movement to be carried on with ease and readiness." Mr. Mansell Moullin finds that the most striking results are furnished by cases which have been treated by bandaging in the conventional way, where the œdema still persists and where there are no adhesions other than those resulting from rigidity of the capsule and the swelling of the soft tissues.

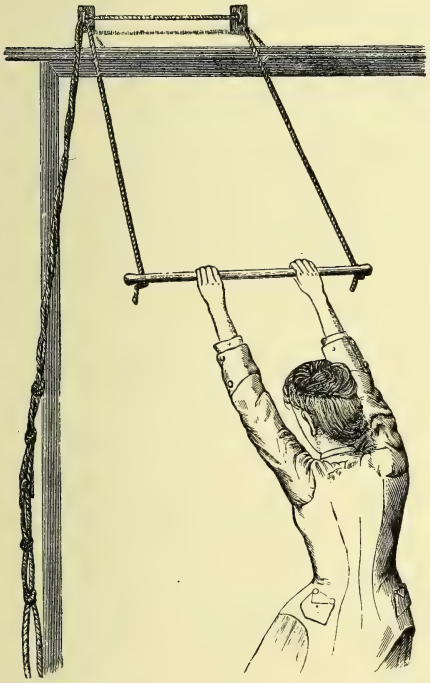
Graham has analyzed the results of 308 cases of sprains treated by massage by himself and several independent observers in Europe. These represented all grades of severity and all varieties of injuries of this general nature. He finds the average length of time for recovery to have been 9.1 days. This average would have been

much diminished if 39 cases in which massage was not begun until from two to twelve weeks after the receipt of the injury had been omitted from the calculation. A study of 55 cases treated in the usual manner by fixation by the same observers showed the average time for recovery to be 26.16 days, or nearly three times as long as similar cases treated by massage.

It is perfectly safe to assert that, as a rule, if a sprain is taken in hand by a competent masseur immediately after the receipt of the injury, and masséed twice or even thrice daily, the time which will be required for perfect recovery will be to that which would be required were it encased in an immovable dressing as a week is to a month. This is indeed a very moderate statement.

It was said by Prof. S. D. Gross that a majority of the cases requiring amputation were the result of sprains. If this be so—and the asser-

Fig. 122.



Vertical Suspension by the Hands, by means of the trapeze, as used in lateral curvature.

Fig. 123.



Self-suspension by means of Dr. Lee's Spinal Swing.

tion is supported by European surgeons—then it is difficult to over-estimate the importance of an early resort to this method in every such injury.

Lateral Curvature of the Spine.—Among the disturbances of muscular irritability and equilibrium, lateral curvature stands prominent. Occurring quite independently of any known mechanical cause,

such as collapse of one lung, traumatic or sequelar abscess of the spinal muscular system, inequality in the length of the legs, paralysis of one arm, and so on, it usually assumes the double or sigmoid form. It is a disease of early childhood, and is much more common in females than in males.

Mechanical therapeutics constitute the only means for its treatment. They are administered with a view to stretching the contracted muscles, developing their overstretched antagonists, improving the general muscular tone, and overcoming distortion. Spinal self-suspension is a valuable exercise for this purpose.

The following is an ordinary prescription for double (sigmoid) right lateral curvature of the spine (upper convexity to the right, lower to the left):

1. Inclined thigh support standing, left arm extension, with double side-pressure.
2. Left-neck rest, inclined thigh support standing, back extension, with double side-pressure.
3. Hanging head backward bending, double side-pressure.
4. Left-neck rest, inclined stride sitting, back extension, with double side-pressure.
5. Hanging, leg abduction and adduction.
6. See No. 4.
7. Left stretch right side lying, stretch holding.
8. See No. 2.
9. See No. 4.
10. See No. 7.

After each movement, standing arm raising forward, upward.

The following is an ordinary prescription for lateral curvature of the spine (single convexity to the left):

1. Inclined thigh support standing, right arm extension, left side-pressure.
2. Right neck rest, while right hip support standing, left, sideways flexion, left side-pressure.
3. Neck rest standing, heels rising.
4. Right stretch right underlying, holding.
5. Right stretch lying, left hip upward pressure.
6. Right neck rest standing, left sideways flexion, left side-pressure.
7. See No. 5.
8. See No. 4.
9. See No. 2.

After each movement, standing, arm raising forward and upward, outward and downward.

(*Note.*—"Neck rest" signifies, having the hands joined behind the neck. "Half neck rest," having one hand in that position.)

Diseases of the Respiratory System.—While it is true that Kelgren and others have published cases of pneumonia which they claim to have cured by massage, the general law, that except as a means of soothing nervous excitement and aiding sleep this therapeutic means is not applicable to acute affections of the vital organs accompanied by febrile reaction, must hold good in reference to that disease. In chronic congestions, however, it may accomplish much good.

Relief is often given to a notable extent in pulmonary asthma by chest percussion and vibration, and forced expiration.

Dr. C. T. Williams, in his work on *Pulmonary Consumption*, says that under the influence of massage appetite and digestion improve and the circulation becomes more vigorous, color returns, and the quantity of food consumed is sometimes astonishing.

Dr. Thomas J. Mays, in a paper on the "External Therapeutics of Pulmonary Consumption," gives the result of his experience in the use of massage in consumption as follows: "Last winter I witnessed a series of very interesting experiments on the physiological effects of massage which were made by Dr. Zabludowski under the direction of my friend and teacher, Prof. Kronecker, in the Physiological Laboratory of the Berlin University, where I was engaged in physiological work at the same time. The results of his experiments, which have since been published in the *Centralblatt für die medizinischen Wissenschaften*, No. 14, convinced me that massage had a tonic and invigorating influence upon the animal body; and during my attendance last spring at the Brompton Hospital for Consumption, in London, I related those experiments to Dr. Bruce of the hospital staff, and he concurred with me in the belief that bodily massage, by arousing the constitutional lethargy present in phthisis, might probably be a valuable adjunct in its treatment. Since my return I have had opportunities to test the efficacy of massage in a clinical way, and it has certainly proved itself to be a most useful addition to the external therapeutics of pulmonary consumption."

It is an error, however, in this disease to attempt to "expand the chest," as it is popularly called, or to make use of very strong respiratory movements. Such efforts may increase congestion, and even provoke hæmorrhage. The advantage to be gained is the general invigoration and improvement of nutrition.

Vocal Gymnastics.—The systematic exercise of the voice according to certain definitely prescribed rules has a far wider effect than the mere strengthening of the vocal organs. This should consist in repeating after the instructor all the articulate sounds of a language: first, the vowel sounds; then the vowels in combination with the simple consonant sounds; and, finally, the most difficult compound consonant sounds. Care should be taken that the mouth be well open, the lips

thoroughly retracted, the head erect in order to open the throat, and the chest well expanded. The exercise should be conducted with sufficient rapidity to slightly accelerate the speed of respiration, and the enunciation made with a sudden and energetic expulsion of the breath. Any one who will go through a solid hour of this drill will find that he has been working. But at the same time, if the severity of the exercise has been properly proportioned to his strength, he will feel a general sense of invigoration rather than of exhaustion. This is due to three distinct causes: First, he has taken into his lungs a very much larger amount of air than he is in the habit of doing. Thus the blood has been able to get rid of its impurities at a more rapid rate, and every tissue of the body has received a fuller supply of healthy nutritive fluid. Secondly, all the muscles of the trunk, but especially the abdominal muscles and the diaphragm, have been called into vigorous action; their circulation has been quickened; a greater amount of blood has been invited into their capillaries; plethora of the abdominal viscera has thus been relieved and nervous irritability diminished. In the third place, the mechanical action of the diaphragm and abdominal muscles upon all the abdominal organs has been such as to subject them to alternate pressure and relief from pressure, thus directly stimulating their circulation and expediting the flow of their secretions and excretions. Thus, not only has the blood been made more fit for the nutrition of the body, but its distribution to every part of the system has been greatly aided and the discharge of effete matters has been promoted. It is not difficult to imagine that an agency capable of calling into play such important activities may possess therapeutic virtues. And such is actually the case. Individuals suffering from general debility, feeble respiration, dyspepsia in several of its forms, constipation, nervous irritability, palpitations of the heart, and narrowness of the chest have been greatly benefited by this gentle but efficient form of muscular exercise.

In CROUP, both *true* and *false*, centripetal stroking of the neck in the manner already described is useful—in the former, by producing local depletion and mechanically aiding in the dislodgment of the membrane; in the latter, by soothing the spasm of the vocal cords and laryngeal muscles.

In acute catarrh of the nose and throat, neck-massage is capable of giving great relief and of shortening materially the duration of the attack.

Diseases of the Female Reproductive System.—In all pelvic engorgements, whether of the uterus, ovaries, or appendages, and in all uterine functional derangements, massage and movements, but especially the latter, are a very valuable adjunct to other means of treatment. Retarded or suspended menstruation can usually be brought to time by

strong movement implicating the psoas and iliacus muscles and the adductors of the thigh. Both the uterus and the ovaries can be reached and manipulated through the abdominal walls. Any additional advantage to be obtained by manipulating these organs directly through the vagina, as recommended by Reeves Jackson and others, is not sufficient to counterbalance the serious objections to the procedure on the score of delicacy and the risk of inducing involuntary erotic manifestations on the part of the patient. In all prolapses, whether of the uterus or ovaries, the assumption of the knee-breast posture for a short time daily, the patient being instructed to open the vagina in order to allow of internal atmospheric pressure, should be enjoined. If taken for a few moments the last thing on retiring, it will often ensure a good night's sleep. Another mechanical resource for the same purpose is to have the foot of the bed a few inches higher than the head.

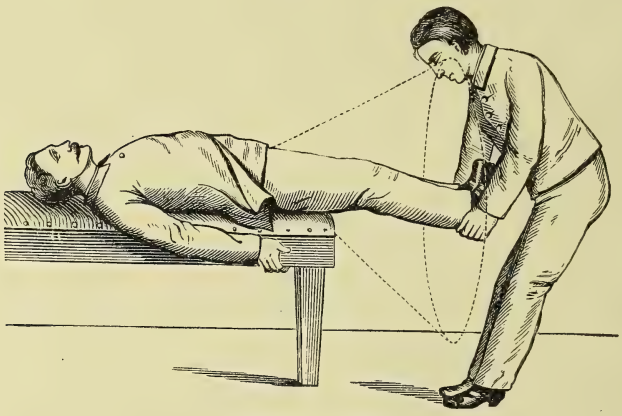
Ovarian Dropsies which have resisted all other methods have sometimes yielded to the employment of abdominal massage. Such a case has been reported by Von Winiwarter: Reasoning from the experience he had had in removing fluid from œdematous limbs, where its absorption by the blood had caused secondarily increased diuresis, which finally led to the entire elimination of the fluid from the body, he assumed that the cyst fluid, which has a low specific gravity, could be likewise removed by mechanical means. While not attempting to decide the question as to whether the fluid is absorbed by the lymph-vessels or the blood-vessels, he combats the idea that resorption is not due to the immediate manipulation of the cyst itself, but rather to the stimulation of the circulation as a whole, which, by leading to increased diuresis, necessarily involves an increased absorption of the cyst fluid. If this latter explanation were the correct one, he maintains, mechanical treatment would be equivalent in its effects to that by diuresis and purgation, yet it is a universally acknowledged fact that the ovarian fluid remains unaltered in quantity even after the most vigorous and prolonged use of diuretics and carthartics.

His mode of treatment of this class of cases has been criticised as involving many difficulties, and being, at the best, but palliative. But to this he replies by showing that in this case massage was of more effect than repeated tapping—that it had not only prolonged life, but had made it as bearable as it possibly could be made without resorting to radical operation. Von Winiwarter therefore regards massage as indicated in all cases of ovarian cyst where from any cause operation is impracticable.

Diseases of the Urinary and Male Reproductive Organs.—The kidneys are so situated as to be quite easily reached by the direct influences of massage and the indirect action of movements of the pelvic and spinal muscles. Even in organic affections, as the various Bright's

diseases, congestions may be relieved and normal circulation promoted in these organs. Dowse has found massage of "the kidneys when they contain gravel and calculi most useful. Deep kneading and percussion

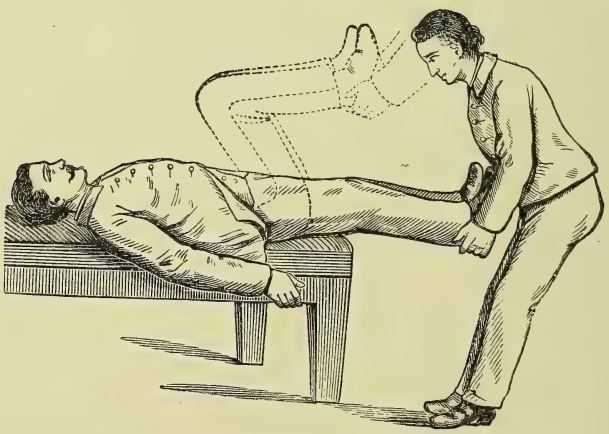
FIG. 124.



Lying, hip rotation.

are necessary, and the operation should be performed daily for a period of two or three months. The attacks of severe pain diminish in fre-

FIG. 125.



Lying, knee-chest flexion and extension.

quency and intensity, and eventually the stones are passed into the bladder."

The relaxed condition of the tissues about the perineum and the crura of the penis which accompanies, if it does not lead to, SPERMATORRHŒA, is capable of remedy by the judicious exercise of certain muscles.

Diseases of the Eye.—The tendency on the part of oculists, as well as of mechano-therapeutists, to make use of massage in the treatment of many affections of the eye is very manifest at the present day. Prof. Costomoris of Athens has obtained excellent results from its employment in the following diseases: acute or chronic follicular conjunctivitis, catarrhal conjunctivitis, œdema, ecchymoses, phlyctenular

Fig. 126.



Massage of the Eye.

ophthalmia, gonorrhœal ophthalmia, croupous and diphtheritic ophthalmia, parenchymatous keratitis, infiltrations, abscesses and ulcers of the cornea, and opacities of the cornea. It was first proposed by Donders in 1872. Landolt uses it, together with boracic acid, in granular affections of the conjunctiva and cornea. Holmes has found its results in pannus extremely rapid, the duration of cases being reduced from weeks to as many days. He attributes these remarkable results to the increased arterial and venous circulation, the breaking down of degenerated epithelial masses, and forcing open occluded lymph-channels, thereby preparing the way for the rapid absorption of pathological products. It will be remembered that it is precisely in this way that the effects of massage on diseased joints are accounted for.

Pagenstecher was the first to reduce massage of the eye to a system. He recommends that the lid which is not being treated be slightly retracted with the middle finger of the other hand. He uses both circular and radial friction, but depends more on the latter. Opacities that had lasted for over thirty years have been removed in this way. The operation should continue about five minutes, and be performed once daily. Episcleritis has yielded rapidly to this method. Klein, encouraged by Gradeniga's demonstration that the intraocular pressure could be diminished by massage, has used it in glaucoma with encouraging results. He considers it allowable, first, in acute and chronic glaucoma, beginning with inflammatory symptoms and accompanied by increased intraocular tension; second, cases in which sclerotomy and iridectomy have proved ineffectual; third, glaucoma accompanied by continual neuralgia, rendering operation impossible; and, fourth, cases in which operation seems directly contraindicated, as in the hæmorrhagic form.

Diseases of the Skin.—Considering the efficacy of massage in restoring a dry, harsh skin to a condition of softness, pliability, and healthy moisture, it is somewhat to be wondered at that so little effort has been made to utilize it in the treatment of diseases of the skin.

Von Mosengeil, it is true, mentions having treated a few cases of elephantiasis with benefit by massage in combination with light bandaging. But the more ordinary cuticular affections seem to have had very little attention paid to them by masseurs.

The only dermatologist who has taken the matter up seriously is Shoemaker. He tells us that in certain morbid states of the integument, when properly used, it is attended with a most beneficial effect, and often results in restoring the surface to its natural condition. Among the special affections in which he has found it useful are psoriasis, scrofuloderma, and trophic disturbances, in which it increases oxidation, removes effete products, and acts as a local as well as a general tonic, increasing the red corpuscles. It is particularly, however, in chronic eczema that he has seen admirable results from its employment. Even when the integument has become quite leathery the application of massage breaks up the exudation, stimulates the absorbents, and removes the inflammatory products. In the dry form of seborrhœa, in loss of hair, indurated acne, glandular swelling, and abnormal pigmentation it has proved of great service. As is well known, many chronic affections of the surface depend on an unhealthy condition of the mucous membrane of the digestive tract, constipation, and so on. The writer referred to points out that in relieving these conditions massage and movements contribute largely to the cure of the former.

Narcotic Poisoning.—The employment of massage and exercise

in the treatment of acute poisoning from opium and other narcotics dates back beyond the memory of man. Its mode of administration has been of course crude. Its object is twofold—to keep the attention aroused, and in this way prevent the brain from yielding to the fatal lethargy; and to promote in every possible way the elimination of the poison by the various emunctories. Percussion in all its forms, especially clapping and flagellation, neck-massage, head-movements, and general massage, are all indicated, the patient being kept as much as possible in the erect posture and in motion. Chloral poisoning has been successfully treated in this way.

Chronic narcotic poisoning or the opium or other habit is greatly benefited by it. Murrell "knows of nothing which so effectually allays the craving for the drug, and enables the patient to dispense with its use, as massage."

In conclusion, if massage and remedial exercises can accomplish the results claimed for them in the foregoing pages, the system is one which the physician should not consider as outside of the line of regular requirement, but rather one with which every medical student and young practitioner who still has time for study should feel it to be his duty to familiarize himself. The country practitioner especially, who cannot avail himself of the services of a trained masseur, would constantly find it greatly to his interest and profit to be able to treat appropriate cases in this way. The physician in full practice, however, will not be able to devote the necessary time to it, particularly in large cities. To whose care shall he confide the patients whom he desires to have treated in this way?

It would seem almost superfluous to say that the most important qualification should be a thorough knowledge of the art. And yet the first inquiry of the physician is too often, Who will do the work cheapest? When we compare the three years' course required in Sweden, and the few days' instruction, or perhaps simply careless observation, which is often thought sufficient in this country to enable an uneducated person to "pick up" massage, can we wonder that in the former country it enjoys the entire confidence of the profession and the public, while in our own it is barely recognized by the mass of the profession? It is not too much to require that no one, of either sex, shall attempt to perform remedial manipulations upon our patients who does not possess a knowledge of the leading facts in anatomy, such as the position and comparative size of the various organs, and the position and course of the larger blood-vessels and nerves, and of such facts in physiology as the functions of the organs, the course of the circulation, and the nature of the processes of digestion, assimilation, and nutrition—of the modes of applying massage and move-

ments in such a way as to secure the best results in the briefest time, and with the least discomfort to the patient; of the effects produced locally and generally upon the system by the different methods of procedure; of the order in which they should be used; and of the injury which may be inflicted by employing them improperly or in inappropriate cases. No one is competent to acquire such knowledge who has not had a certain amount of education.

In order to be acceptable to the patient, the masseur or masseuse should be quiet in manner, pleasing in address, and scrupulously neat in person and attire. Vigorous health, muscular strength, and a soft and pliant hand with not too moist a palm, are matters of much importance as regards the physique. To these endowments of nature and education must be added a manual dexterity in the application of the various procedures which can only be acquired by careful training under an experienced instructor. Hence it will be understood that the stable and the laundry are not, on the whole, as many physicians appear to think, the best schools from which to graduate practitioners of this art.

In the preparation of this article, which is necessarily somewhat encyclopædic in its character, free use has been made of the works of Drs. Joseph Schreiber, William Murrell, Douglas Graham, G. Norström, and Albert Reibmayr. The writer desires to make this general acknowledgment to these authors, in case their names have not been mentioned in every instance in which they have been quoted.

GENERAL EXERCISE.

By EDWARD MUSSEY HARTWELL, Ph. D., M. D.

All remedial measures which are not blindly traditional are of necessity based upon and prompted by physiological conceptions. The fundamental conception of modern physiology regards the living body as a physical mechanism "whose proper working," to borrow Huxley's words, "we term health; its disturbance, disease; its stoppage, death." It is therefore not surprising that therapeutical measures should become somewhat more direct and mechanical in their character as our knowledge of the nature and course of the various activities and perturbations of the body is extended and rendered more and more precise. Surgery is now coequal with medicine, its base mechanical origin being no longer remembered against it. Hydrotherapy having been rescued, in a measure, from the control of laymen, has, at least in Europe, been accorded a corner in the domains of legitimate medicine. The emancipation of mechano-therapy, which of old stood above surgery, and on a par, to say the least, with hydrotherapy, is of more recent date, and has been less complete, especially among English-speaking peoples.

The term mechano-therapy and the class of procedures denoted by it are so uncommon, or little thought of, in the British Isles and America as to be practically neglected in the dictionaries of Dunglison and Quain. The term "mechano-therapy" has, however, the sanction of foreign usage, and is defined in the *National Medical Dictionary* of Billings as "the treatment of disease by mechanical means, such as massage, exercise, etc." We may use the term, then, to denote medical gymnastics or exercise and massage, though some writers employ it to denote massage alone.

The ends of exercise are essentially the same whether it be employed for recreative, hygienic, educational, or purely remedial purposes. To make rational and proper use of it, for any of the purposes named above, one must have a clear conception of the physiological principles of exercise, to begin with. It behooves us, then, at the outset, to consider somewhat closely the nature and effects of exercise.

It is interesting to note that our word exercise, and *exercitus* the Latin word for the body of best-trained men in the state, the army,

are derived from the same verb, *exerceo*. The Greek synonym for *exerceo* is *ἀσκέω*, and meant originally to work raw material. In classic times it meant to exercise, to train in the strict athletic or gymnastic sense; later, in the early days of the Church, it signified to discipline the flesh, to mortify the body, and to it in this sense the English word "ascetic" owes its origin and present meaning. The original ascetic was simply an industrious and careful gymnast or athlete.

The best comprehensive definition of exercise, that has come under my notice, is that given by Du Bois Reymond, professor of physiology in the University of Berlin. "By exercise we commonly understand," he says, "the frequent repetition of a more or less complicated action of the body with the co-operation of the mind, or of an action of the mind alone for the purpose of being able to perform it better." Practically, all human actions are comprised under the two heads of this definition of exercise. Bodily actions demand our chief consideration.

It is far easier to underrate than to exaggerate the part which muscular actions play in human life. Imagine the condition of a man perfectly formed, generously endowed, and in his prime, whose single lack should be that sensible warm motion that has its seat in the muscular tissue. The position of a fly in amber would be lively and preferable to the isolation of such a man. Of course he could not "do business," but he could think and fear and hope. He must face the future, lying like a log in whatever position he may happen to fall. His face will be absolutely destitute of expression, and his eyes fixed under closed lids. He can neither smile nor weep. His hunger cannot be appeased nor his thirst slaked. His heart may "burn within him," but it shall not pump blood, so that he will be pulseless as well as breathless and bereft of speech. Unable to stir the tip of a finger or to raise a hair, he will be powerless to express his thought or aspiration, or to impress his conceptions or wishes upon any creature. In short, such a man would be an incorruptible cadaver.

Without muscular tissue, then, we cannot live or move. Its importance to the body is also to be inferred from its mass and weight. Nearly, if not quite, one-half of the human body, by weight, is made up of so-called voluntary muscles. The skeletal muscles, moreover, are estimated to contain one-quarter of the blood in the body; and it is through their activity that a large portion of the potential energy of the body is turned into work and heat.

A freshly-dissected skeletal muscle of one of the higher animals presents a smooth surface, rounded outlines, and a glistening appearance, due to its sheath of connective tissue. Inward prolongations of this sheath pass into the substance of the muscle, and divide it into

bundles of fibres, technically called fasciculi or packets. Each fasciculus consists of a number of fibres running parallel to one another. The fibres are separated from one another by connective tissue, just as the fasciculi are. The muscle-fibre or cell is the ultimate and essential anatomical element of muscular tissue. Each fibre consists of a soft, contractile, semifluid substance contained in a tubular sheath—the sarcolemma, which is transparent, tough, and elastic. Fibres vary in diameter from $\frac{1}{600}$ to $\frac{1}{100}$ of an inch, and are seldom longer than $1\frac{1}{2}$ inches. These fibres or cells are arranged in linear series and do not inosculate with each other. The amount of shortening in a contracting muscle is equal to the summated contractions of its individual fibres.

If we lay bare a muscle in a living animal, we may cause it to contract before our eyes, either by bringing a heated body close to it; by giving it a slight tap; by applying certain chemical substances to it, such as ammonia, lime-water, or a solution of common salt; or by giving it an electric shock.

When a muscle outside the body is acted upon suddenly by an appropriate stimulus, it quickly shortens, and then, if it has been loaded with a weight, rapidly returns to its former length. A weighted muscle outside the body, or one in the body which acts against resistance, does work every time it contracts. Its work is chiefly of the sort which physicists have named mechanical work, and is equal to the product obtained by multiplying the weight lifted by the distance through which it is lifted against the force of gravity. Its measure is expressed in foot-pounds. A muscle with no weight attached does no "work" when it contracts, nor does it do any work if it is loaded with a weight too heavy for it to lift. Of two muscles equal in cross-section, the longer can do more work; whereas if two muscles are of equal length, that which contains the greater number of parallel fibres will do more work than the other. It is estimated that a square centimetre of human muscle can just lift a little more than twenty pounds. Muscles are somewhat elastic, and in the body are slightly overstretched.

Besides its contractile substance, its tendons, and the sheaths which invest its fasciculi and fibres, every muscle has blood-vessels and nerves, whose functions must be considered before we can arrive at a clear understanding of muscular exercise. Muscle-arteries and veins usually lie alongside of each other in the connective tissue which surrounds the fasciculi, while their capillaries form a fine meshwork of vessels, lying between and upon the muscle-fibres, but without penetrating the sarcolemma of any fibre. Along with the blood-vessels, lymph-capillaries are found in the interstices of the connective-tissue sheaths of the muscle-fibres, and of the tendons also. The lymph in these spaces is derived by transudation from the blood-capillaries on the one hand, and from

the muscle-fibres on the other. The fibres are therefore bathed in lymph, and derive their food-supply from it by absorption through their tubular sheaths. From this state of things there results an inward and outward stream or interchange of material between the muscle-substance and the blood through the capillary wall, the lymph-spaces, and the sarcolemma.

The nerve-fibres found in the muscles are of two sorts: the white or medullated, which are distributed to the muscle-fibres; and the gray or non-medullated, which are distributed to the plain muscle-fibres contained in the muscle-arteries and veins. The motor nerve belonging to a muscle usually enters the muscle at its middle point. It then divides and subdivides into so many branches that every muscular fibre receives a nerve-fibre. Where the nerve-fibre pierces the sarcolemma the axis-cylinder spreads out, forming an eminence of protoplasm within the sarcolemma. This eminence is known as the "motorial end-plate." The branches of the axis-cylinder traverse this end-plate, and subdivide into fibrils which penetrate the contractile substance of the fibre. Only the axis-cylinder of the nerve passes within the sarcolemma, since the outer sheath of the nerve-fibre coalesces with the sarcolemma itself, and the medullary sheath ends at the sarcolemma.

We have, then, the contractile substance of the muscle-fibre connected with the irritable stimulus-generating and transmitting substance of a central nerve-cell, situated in the spinal cord or the brain, the connecting link being the axial fibre of the motor nerve, which is simply a portion of the nerve-cell's contents long drawn out in the form of a strand, until it reaches the muscle-fibre, where it spreads out to form the end-plate, and then subdivides into fibrils which penetrate the muscle-substance. What is true of a single muscle-fibre is true of all the fibres in a given muscle; and what is true of one voluntary muscle is true of the entire five hundred. Voluntary muscles have sensory as well as motor fibres. They are the channels for the impulses which give rise to muscular sensibility, and are connected with centrally-situated nerve-cells which minister to our muscle-sense — the sense, that is, which keeps us informed concerning the condition of the muscles and the extent to which they are contracted.

A single muscle, then, is to be considered as an aggregation of a vast number of contractile fibres arranged in myriads of linear series, which in turn are gathered into bundles, all of which, along with their accompanying nerve-fibres and nutrient blood-vessels, are supported and bound together by means of elastic connective tissue. The muscle, so made up, has its own special sheath, and is bound by its inelastic tendons to the bones which it is set apart to set in motion. Muscular contractions can be brought about through the direct applications of chemi-

cal, thermal, mechanical, or electrical stimuli to the muscle itself. If the nerve of a muscle be excited by pinching it, by beating it, by applying certain chemicals to it, or by electrifying it, the muscle is indirectly stimulated to contract by means of the motor impulses discharged into it through its motorial end-plate. The motor nerve may be stimulated at any part of its course. Again, the muscle may be set in action through stimulation of the centres whence its nerve-fibres emerge by any of the stimuli mentioned above. Normally, the muscle-centres are stimulated chiefly by "volitional" stimuli.

The effects of exercise upon a muscle and the parts connected with it next demand our attention. Immediately a muscle begins to contract, under whatever stimulus, the blood-stream passing through it becomes changed, both in respect of quantity and quality. The arterial twigs which ramify within it dilate; more blood is poured into the capillaries surrounding its fibres; more lymph passes to the muscle-substance; and the outgoing streams of lymph and blood, in the lymph-capillaries and veins respectively, are augmented.

The blood which enters the muscle is bright red in color, rich in oxygen, and poor in carbonic acid. That which leaves it is dark blue in color and of a higher temperature, richer in carbonic acid, and poorer in oxygen, and contains various products having an acid reaction, due to the chemical changes which take place in the food-material supplied to the muscle-substance, and in the muscle-substance itself. If the supply of arterial blood to a muscle is cut off or diminished, its irritability is lowered; that is, a stronger stimulus is necessary to make it contract. The same result follows, also, if it is fed with blood deprived of oxygen or otherwise poisoned, or if the muscle-vein is tied and the waste-products, normally drained off through the veins, are retained within the muscle. The irritability of a muscle is also lowered by prolonged stimulation, even when its in-going and out-going blood-streams are unobstructed. If these disturbed conditions do not persist until the muscle-fibres pass into the condition known as death-stiffening, the irritability of the muscle may be restored, either by sending fresh blood through it, by sending a stream of some indifferent fluid through it, or by ceasing to stimulate it.

In the first case, restoration is brought about through the renewal of its supply of food-material and oxygen; in the second, by clearing out the noxious waste-products; and in the third, by allowing it to rest a while. These, then, are the main conditions demanded for the health of a working muscle: A full supply of proper food and oxygen; unimpeded and sufficient drainage; and rest at due intervals. Given these three conditions in the body, and exercise of a muscle causes it to increase in size and weight, within certain limits, through the increased size and number of its fibres. Furthermore, a working muscle differs

from a resting muscle in that it is appreciably hotter; by the presence of a low murmur, called the muscle-sound, which is caused by the more rapid vibration of the particles of the slightly overstretched fibres; and on account of certain electrical peculiarities which it presents.

Mention should be made of the fact that a muscular contraction presents three phases—viz. the latent period, the phase of shortening and thickening, and the relaxation period, during which the muscle is returning to its original form. There is practically no change of bulk during the contraction of the mobile muscle-substance. The length of the different phases varies under various conditions. The contraction phase is the most important of the three. The causes which determine the character of the phase of relaxation have not been fully made out.

A muscle habituated to exercise can do more work, and do it better, than an unexercised muscle; and for two reasons: exercise makes the muscle larger, harder, stronger, and more enduring, improving it simply as a tool in all its structure; and, secondly, the muscle responds more quickly and completely to the stimuli which stir it up to work. In other words, the muscle becomes more obedient to its stimulators, the nerve-centres, through its better acquaintance with them. A muscle, then, is a neuro-muscular machine for developing power, for transforming the potential energy stored up in its substance and the blood brought to it into one or another form of the energy of motion.

If we consider a single muscle as a mechanism for developing energy of motion, it may be compared to a peculiarly-arranged collection of cartridges loaded with powder and connected by wires with a series of electrical batteries. Each muscle-fibre would, in that case, stand for a single cartridge, the shell of the cartridge being represented by the sarcolemma and contractile substance; the charge of powder by the unstable chemical compounds stored up or loosely held in the contractile substance; the wire from the battery by the motor nerve-fibre, and the cells of the battery by the cells of the nerve-centre; and the electric current by the nervous stimulus, which, passing along the axis-cylinder through the nerve-plate into the contractile substance, gives rise to the phenomena which signalize a muscular contraction.

When a cartridge is exploded chemical actions take place which result in the sudden formation of gas, accompanied by the development of light, heat, and sound, and the production of a residue of smoke and ashes. If the cartridge-shell be tight and tough, the motion of the molecules of the suddenly-formed gas will be communicated to its particles and the shell be shaken or moved from its position. By varying the construction and arrangement of the cartridges we may cause the liberated energy of the explosive to set projectiles in motion, to rend rocks, or to move parts of mountains. The results of chemical explosions in the muscle-cartridges are less

violent than those above noted, but they are sufficiently similar and well marked to be termed parallel to them. The potential energy of the muscle-fibres is transformed into the energy of motion through the decomposition of the chemically-unstable contents of the sarcolemma. Heat, sound, electrical changes, and mechanical motion are evolved. The mechanical arrangement of the parts of the muscle is such that the total motion of the mass of its fibres is communicated by the tendons of the muscle to the parts of the body with which it is connected. So long as the muscle-fibres are properly nourished, and not too severely stimulated, the muscle-cartridges may be said to reload and maintain themselves in a state of readinesss to go off on the receipt of stimuli from the central battery.

Muscles are more perfect power-machines than are steam-engines and rifled cannon, not only because they develop more work out of the energy stored up in the substances on which their activity depends, but also because they are distinguished from all machines of human manufacture by the fact that they are self-improving machines; that is to say, they become tougher and stronger as structures through exercise, and at the same time more capable and adaptable functionally. Growth or increase in the size, and probably the number, of its structural elements, and development, or increased facility in its functional activity, are the main effects of exercise upon a single muscle. The same is true of the muscular system as a whole. Exercise enlarges and strengthens it on the one hand, and renders it more responsive and discriminative as regards stimuli on the other The body, as a whole, is a machine in which the potential energy of organized material is transformed into the work which we see manifested in motion, animal heat, and the chemical actions involved in nutritive, secretory, and excretory processes. It is estimated that the tissue-changes of which a human adult body, weighing one hundred and forty pounds, is normally the seat involve the transformation of more than a ton of material in the course of a year. Muscular activity is one of the chief agents in promoting wholesome tissue-changes in all the bodily organs, and in determining the normal growth and development of the organism as a whole.

Broadly speaking, the skeletal muscles and the skeleton constitute the working or executive machinery of the system of federated tissues and organs which make up the body; and the most obvious results of orderly and well-regulated exercise are found, as we have seen, in the normal growth and development of the executive machinery itself. But the executive machinery of the body is ruled and governed by the nervous system. The muscular and nervous tissues have been well characterized as the "master tissues." Foster in the fifth edition of his *Textbook of Physiology* points out that the whole of the rest of the

body is engaged (1) "in so preparing the raw food, and so bringing it to the nervous and muscular tissues, that these may build it up into their own substance with the least trouble; and (2) in receiving the waste matters which arise in muscular and nervous tissues, and preparing them for rapid and easy ejection from the body."

The general effects of muscular exercise upon the master tissues have been pointed out already. The consideration of the more special effects of such exercise upon nervous tissue, "the masterful tissue," so to speak, may be deferred advantageously until we have discussed the influence of muscular exercise upon what Foster compendiously denominates "the tissues of digestion" and "the tissues of excretion," including under these heads all tissues and organs not classed as master tissues or indifferent tissues.

The muscular system has, then, two sets of servants—its purveyors and its scavengers. The former prepare and serve its food-materials, and the latter clear away the refuse matters which result from the chemical and mechanical processes by which its functional activity is signalized. The digestive and assimilative organs, and the arterial section of the organs of circulation and respiration, belong to the first class, and the venous section of the circulatory and respiratory organs, the perspiratory and urinary organs, constitute the second set. The purveyor and scavenger tissues serve each other, as well as the master tissues, it may be remarked, and are, like the muscles, controlled by the Archæus of the body, if we may so denominate the nervous system. Despite the number and efficiency of these purveyors, the muscles are obliged to work for their living, since the food supplied to them requires to be appropriated and elaborated. Living muscular substance is continually building itself up out of the proteid, fatty, and carbohydrate material, saline matters, and oxygen brought to it by the blood; that is to say, the lymph. At the same time, muscular substance is continually, by reason of its innate metabolism, forming products to be disposed of by the scavenger tissues, which naturally have most to do during muscular exercise and just after it. A resting muscle forms nitrogenous waste, such as kreatin, and gives off carbonic acid, and probably other matters, too; while in a contracting muscle there is a marked increase of waste given off, which consists chiefly of carbonic acid and sarcolactic acid, there being no marked increase of nitrogenous waste. In either case, the waste products drain away through the lymph- and venous channels, and are eliminated by the lungs, the kidneys, or the skin.

Next to the movements due to muscular action, the most direct and obvious effects of exercise are increased circulation and increased ventilation of the blood. The effect of exercise upon the processes of diges-

tion, sanguification, and excretion is an indirect one; those processes being modified, so far as muscular activity is concerned, by the changes wrought by it in the volume, distribution, or character of the general blood-stream.

The blood-stream flowing through a contracting muscle is at once increased in volume, and very soon changed in its chemical character, especially on its venous side. Its increase in volume is primarily due to the dilatation of the muscle-arteries and veins, and to the attendant quickening of the lymph-streams within it. This dilatation is a vaso-motor effect, resulting, as it is usually held, from the passage of dilator-nerve impulses, arising in the spinal cord, to the muscular coat of the muscle-arteries. Local diminution of blood-pressure is normally the result of arterial dilatation within a limited muscular area, provided the heart-beat and general blood-pressure remain unchanged. If arterial dilatation occurs within a considerable or enlarged muscular tract, a fall in the general blood-pressure may result, and the heart be called upon to quicken and strengthen its beat.

On the other hand, the qualitative changes in the blood which issues from muscles in contraction are such, when those muscles are at all numerous, as tend to make the general blood-stream in the right heart and the pulmonary circulation more venous than usual. The carbonic acid, or other waste, stimulates the respiratory centre in the medulla, and leads to an increase in the number and amplitude of the movements of respiration. The flow of blood to and through the heart and lungs causes a quickening and strengthening of the heart-beats. The same changed condition of the blood suffices to dilate the vessels of the skin and start the perspiratory mechanism into action, and thereby to dissipate the excess of heat produced in the blood by the metabolism of the contracting muscles, which are the principal sources of bodily heat. The dilatation of the cutaneous vessels likewise tends to diminish the peripheral resistance to the contraction of the left ventricle of the heart, thus reinforcing the simultaneous fall in the general blood-pressure caused by the dilatation, alluded to above, of the muscle-arteries. Exercise may therefore, through its indirect influence upon the skin, as well as by its direct vaso-dilator effect within the muscles, impose additional labor upon the heart. It is probable that a means of maintaining, or even increasing, the mean blood-pressure of the body, without appealing to the heart for extra effort, exists in the augmented constriction which takes place in the arteries within the abdominal splanchnic area during vigorous muscular labor. By this means the heart is spared redoubled labor, and the digestive organs are left at rest when they ought to rest. The fact that to fill the blood-vessels of the muscles and skin the splanchnic vessels are proportionately emptied, and *vice versâ*, is one of great practical importance, and

points to the impolicy of engaging in any but the most moderate muscular exercise while the digestive process is in full course.

The effects of muscular exercise may be summarized under the heads of extrinsic and intrinsic, and these, in turn, may be characterized as direct or indirect.

The most important direct intrinsic effects are: a greater flow of blood and absorption of oxygen and food-materials, and increased metabolism, resulting in mechanical work, the evolution of heat, and the formation of waste within the muscles. Under indirect intrinsic effects belong improved nutrition, structural enlargement, and improved function of the muscles.

The following are to be considered direct extrinsic effects of exercise: vascular dilatation, enlarged flow, and diminution of blood-pressure on the arterial side of the circulation; on the the venous side, an enlarged flow of the lymph- and blood-stream, which has a heightened temperature, and an increased amount of waste matters; an increase in the force and frequency of the heart-beats; and an increase in the number and amplitude of the respiratory movements. Perhaps the increased elimination of carbonic acid and watery vapor by the lungs, and their increased taking in of oxygen, had best be placed here. If so, the delivery of completely arterialized blood by the lungs to the left heart may be termed one of the direct effects of exercise.

The following may be classed as indirect extrinsic effects: viz. the depuration of the blood, so far as the action of the sweat-glands, the kidneys, and the liver are concerned in it; the dilatation of the cutaneous vessels, and the consequent cooling of the blood and the maintenance of the normal bodily temperature; vaso-motor changes and the variations in blood-pressure, especially in the abdominal sections of the circulation; and the promotion of the nutrition and functional ability of all the tissues, owing to the better character of the blood furnished them and to the more effective play of the organs of circulation.

All mention of the intrinsic and extrinsic effects of exercise upon the nervous system has been omitted in the foregoing summary, for the reason that those most important effects will be treated separately later on. The capital importance of the extrinsic effects of exercise upon the circulatory and respiratory mechanisms has been most forcibly put by Michael Foster. "The capacity for arduous muscular labor," he says, "is determined, not by the respiratory mechanism alone, nor by the vascular system alone, but by both, and especially by both working together in harmony and concert. The increased ventilation would be idle unless it were accompanied by a quicker circulation, and the quicker circulation would similarly be of comparatively little use unless accompanied by increased ventilation. . . . . And, as a rule,

it may perhaps be said that when two men differ in their capacity for strenuous work, such as running a race, the difference, though it is often familiarly spoken of as one of 'wind,' or power of breathing, is in reality not a difference in ventilating capacity, but a difference in the power of the heart to keep up and work in harmony with the increased respiratory movements."

If we bear in mind that next, perhaps, to an adequate supply of proper food nothing so promotes the normal growth and development of the body as well-regulated muscular activity, it is interesting to compare the children of different classes of the population as regards their height and weight. Although Dr. Bowditch, professor of physiology in the Harvard Medical School, and others in America have made valuable observations in this field, still, as more interest has been shown in this kind of investigation in England, where classes as such are more easily studied than with us, and the value of exercise, especially that derived from athletic sports, has been longer and more generally recognized, I shall cite here English observations only.

The very complete and valuable tables published by Dr. Charles Roberts of London touching the mean height and weight and annual rate of increase in the case of some 7800 boys and men, between ten and thirty years of age, belonging to the artisan class on the one hand, and 7700 males, between ten and thirty, belonging to the most favored class on the other, show that the mean height of the artisan class is, for the whole period, about three inches less than the mean height of those belonging to the most favored class. In the latter class public-school boys, military and naval cadets, university and medical students were included. Although the inferior stature of artisans may be to some extent an inherited characteristic, it is held to be chiefly due to "the continuous operation of various conditions of life which retard and arrest growth, and which are most influential when growth is most rapid." Among the conditions so operating "scanty feeding and wearing toil," as contrasted with "abundant nourishment and moderate exercise," occupy a prominent place. These tables also show a progressive gain as regards weight on the part of the favored over the industrial class, both absolutely and in relation to height throughout the entire period under review. At the age of ten years the boys of the most favored class exceed the artisans' sons by one pound in weight; at twelve their excess in weight has increased to four pounds, and at thirteen they are ten pounds ahead. At the age of twenty well-to-do English youths have a mean weight of eighteen pounds more than that of handicraftsmen of the same age living in large towns. As regards chest-girth—and well-directed exercise tells directly upon chest-capacity—the most favored class is clearly superior to the industrial, which superiority is progressively increased until nearly adult life. In

another of Dr. Roberts's tables it is shown that the sons of professional men living in the country exceed town boys of the same class by about an inch as regards height at all ages between ten and twenty, and as regards weight by an amount varying from one to seven pounds. It also appears that the sons of soldiers, policemen, messengers, and the like, are from one to four inches less in stature and from four to thirteen pounds less in weight than boys of the same age whose fathers are devoted to intellectual pursuits; that the sons of artisans and factory operatives are the shortest and lightest of all youthful Britons with the exception of idiots and imbeciles of the same age, who have a mean height of an inch less than even youths of the artisan class. American boys seem to be a little taller and a little heavier than their English cousins of the same age and class.

Dr. Boulton, another English student of anthropometry, made observations extending over ten years on a certain group of children, all of whom were healthy and the offspring of well-to-do parents. Dr. Boulton finds that "average English children brought up under favorable circumstances grow from two to three inches a year. A growth of less than two inches or more than three should excite apprehension; the former would indicate arrested development. The rate of growth should be regular, and being so prognosticates future good stature." As to weight for height, whether a child grows two, two and a half, or three inches in a year, weight for height should be in each case identically the same, and all healthy children should grow broad in proportion to their height. "Between three and four feet the increase in height should," he says, "be two pounds per inch, and between four and five feet two and a half pounds per inch. Well-nourished children, of healthy parents in favorable surroundings, generally attain these averages. But what of children that fall below the standard? I find there is a seven-pound margin of safety, and that children falling more than seven pounds below this standard are devoid of reserve of stamina on which to draw, and consequently succumb quickly to many constitutional diseases. This, then, may be called the preventive medicine margin beyond which lies the dangerous land of cachexia."

There is a condition of mind and body not infrequently seen nowadays in children and youths, especially among females, which is characterized by an irritable, easily overwrought, and unsteady nervous system, arrested muscular development, disordered digestion, and enfeebled powers of assimilation; which might well be called *cachexia scholastica*, since it is largely, and sometimes directly, brought about by ignorant and foolish parents and teachers, who force and cram and overwork the undeveloped brains of children, and at the same time, by neglecting or frowning upon their play and exercise, do their best to retard the

growth and development which they ought to promote and might regulate.

The late Alexander Maclaren's experience, with the first squad of twelve non-commissioned officers sent to him to be qualified as instructors in gymnastics in the British army may serve to show how systematized and well-directed exercise may be made to influence bodily development in a comparatively short time. The twelve men alluded to ranged between nineteen and twenty-nine years of age, and had seen from two to twelve years' service. At the end of eight months' gymnastic training the increase in the measurements of the men was as follows:

	Weight.	Chest girth.	Forearm girth.	Upper-arm girth.
The smallest gain . . .	5 lbs.	1 inch.	$\frac{1}{4}$ inch.	1 inch.
The largest gain	16 "	5 inches.	$1\frac{1}{4}$ inches.	$1\frac{3}{4}$ inches.
The average gain. . . .	10 "	$2\frac{7}{8}$ "	$\frac{3}{4}$ inch.	$1\frac{3}{4}$ "

"The muscular additions," says Maclaren, "to the arms and shoulders and the expansion of the chest were so great as to have absolutely a ludicrous and embarrassing result, for before the fourth month several of the men could not get into their uniforms, jackets, and tunics without assistance, and when they had got them on they could not get them to meet down the middle by a hand's breadth. In a month more they could not get into them at all, and new clothing had to be procured, pending the arrival of which the men had to go to and from the gymnasium in their great-coats."

Enough has been said, I think, to show that muscular exercise exerts a potent and important influence upon the growth of the body and upon the elaboration and perfecting of its more familiar systems of organs; but thus far its most important effect, that upon the nerves and brain, has only been alluded to. The nervous element involved in muscular exercise is oftener overlooked than recognized by the mass of writers on the subject. Maclaren, whose book on *Training in Theory and Practice* is one of the best of its class in the English language, defines exercise as "muscular movement" simply, and declares its object to be "the destruction and renovation of tissues." This is the ordinary view, from which one finds but little deviation in the vast majority of the textbooks on physiology, and of the books and articles on exercise, whether they have been written for school-girls or medical students.

"We seek in vain in most physiological textbooks," says Du Bois-Reymond, "for instruction respecting exercise: if it is given, only the so-called bodily exercises are generally considered, and they are represented as merely exercises of the muscular system. Therefore it is not strange that laymen in medicine, teachers of gymnastics, and school-

teachers believe this. Yet it is easy to show the error of this view, and demonstrate that such bodily exercises as gymnastics, fencing, swimming, riding, dancing, and skating are much more exercises of the central nervous system, of the brain and spinal marrow. It is true that their movements involve a certain degree of muscular power; but we can conceive of a man with muscles like those of the Farnesian Hercules who would yet be incompetent to stand or walk, to say nothing of his executing more complicated movements."

The arm of the blacksmith has been brought into play so often, by writers and talkers on exercise, that every school-boy credits the statement that muscles grow larger, harder, and stronger when duly exercised, and become weak, flabby, and wasted if they are suffered or forced to remain inactive. It is less obvious, though it can hardly be doubted, that use and disuse work similar effects in the case of nerve-cells and fibres, both sensory and motor. Though conclusive evidence is lacking on this point, it seems probable that exercise of the muscles not only reacts upon the nerves and centres, with which they are connected, in such wise as to enhance the power and ease with which they originate and transmit motor impulses, but that it also leads to an increase in the number, size, and elaboration of their parts. That disuse of end-organs, both sensory and motor, leads to atrophy of their nervous connection has been clearly made out. Meynert quotes Mendel as saying "that nerve-tissue, like muscular tissue, increases during mental work."

The fact should never be lost sight of that a single muscle is not a simple organ, but is made up of two clearly-distinguishable though conjoined mechanisms—a contractile, executive mechanism, the muscle proper, and a stimulating, regulative mechanism, consisting of nerve-fibres and gray-matter nerve-cells. Each mechanism has its blood-vessels and lymph-capillaries for supplying food and drainage, and the amount of blood supplied to each is proportionate to its functional activity. If in life the two mechanisms become dissociated, or if either suffers from malnutrition, unregulated exercise, or structural depravity, the dual organ is thrown out of gear, and its working becomes disordered or abolished, in much the same way as when the attempt is made to split a human being into a mental part and a bodily part, and to train the dissevered fractions to functionate as entities. Muscular movement is, then, a resultant effect due to the balanced working of the conjoined mechanisms alluded to. The nervous mechanism is concerned in a somewhat higher kind of work than that of its muscular colleague, and may be said to *represent* the movements of which the latter is the seat and instrument. Between the nervous arrangement which represents the twitch of a single subcutaneous muscle inserted into the base of a hair-follicle, and that which represents and governs

the varied and rapid muscular adjustments which characterize the hand and fingers of a cunning craftsman or artist, there exists every grade of complication.

If we compare an adult man and one of the highest of the lower animals in respect to the movements of which they are capable, we find that they possess many in common, but that man is distinguished from the brute by certain movements, such as those involved in maintaining the erect posture and in the action of the hands and vocal organs, and that, corresponding to these two classes of movements, there are two classes of nervous mechanisms by means of which they are represented. These mechanisms have been well termed fundamental and accessory, respectively.

Similarly, it is demonstrable that while the human infant and adult possess many nervous mechanisms identically alike in structure and function, the adult is characterized by certain other mechanisms whose structural peculiarities, connections, and powers have been evolved and superadded as the result of growth and training. The law of evolution, as applied to the nervous system, is coming to be very generally recognized by neurologists. It is a law which educators, both mental and physical, should ponder upon and be guided by. Dr. Ross of Manchester, England, in his *Diseases of the Nervous System*, in speaking of this law, which was originally enunciated by Herbert Spencer, describes it as "a progressive integration both of structure and function, during which there is a passage from the uniform to the multiform, the simple to the complex, from the general to the special." "During the evolution of the nervous system of man," he says, "the fundamental portion is first developed. The nervous system of man is at first similar to that possessed by all animals which possess a nervous system, or, at any rate, all those which are sufficiently elevated to possess a spinal cord; but as development proceeds the nervous system of man becomes gradually differentiated from that of an ever-increasing number of the lower animals, while still maintaining a general likeness to the nervous system of the higher animals up to the time of birth. This, then, constitutes the fundamental portion of the nervous system of man; but after birth the accessory portion, which up till this time only appears in a rudimentary condition, now undergoes progressive development. It will thus be seen that the fundamental portion is first developed, and that the superaddition of the accessory portion greatly increases the multiformity, the complexity, and the specialty of the human nervous system, and that it is the latest product of its evolution."

As might be expected, the structural elements of the nervous system follow this law. The many-branched nerve-cells, having a process prolonged to form the axis-cylinder of a nerve-fibre, are the most

highly organized and special of nerve-cells, but they begin as small, round, uniform, unbranched cells. The medullated nerve-fibre, made up of axis-cylinder, sheath of white substance, and outer investing membrane, is the highest form of nerve-fibre. At the other end of the series stand the primitive nerve-fibrils, a bundle of which may be said to constitute an axis-cylinder. Among intermediate forms are axis-cylinders with no sheath whatever, axis-cylinders covered only by a sheath of white substance, and non-medullated fibres, consisting only of an axis-cylinder enclosed in a fine, thin, structureless sheath. At birth the fundamental portion of the nervous system of a human infant is characterized by the presence of branched cells and medullated fibres in contradistinction from the rudimentary accessory portion, which contains small round cells, primitive fibrils, and non-medullated fibres. Later, if all goes well, the round cells become branched and the non-medullated fibres become medullated.

Ross has much to say of the distinction, noted above, between accessory and fundamental structures and functions. "The movements of the hand," he says, "afford the best example of the accessory functions of the spinal cord. These movements are peculiar to man, and by far the greater number of them are acquired after birth. It may therefore be expected that the development of the structure which represents these movements in the spinal cord will also take place after birth. The movements which are most characteristic of the upper extremity in man are those of pronation and supination of the forearm and the complicated movements of the hand and fingers; and it is exceedingly probable that the structural representatives of some, if not all, of these movements are to be found in the median group of cells. These cells appear at a late period of the development of the cord, hence they form a specialty of structure which corresponds to some specialty of function. Again, they maintain a small size even in the adult cord, and consequently may be expected to preside over the action of small muscles, both of these conditions being realized in the hand.

"The smaller median area in the lumbar enlargement of the cord," says Ross, "presides probably over the movements of the lower limbs which distinguish the adult man from the lower animals, and also from the human infant. These movements are mainly executed by the extensors of the leg on the thigh, and probably also by the adductors and by the flexors of the foot on the leg. Indeed, the slight elevation of the ball of the toe, so as to allow the passive leg to swing forward by its own weight in walking, is the last movement acquired by the child; and we shall subsequently see that it is the first movement to be affected by disease. If, then, the median area of small cells be the structural correlative of the later-acquired and more special movements of the limbs, it must be absent in those portions of the cord which do not

supply nerves to limbs; and we have already seen that this area is absent in the dorsal and upper cervical regions of the cord."

The same author attributes the spinal-cord regulation of fundamental voluntary movements to its antero-lateral group of cells, and notes that "the cells of this group always maintain the lead in the course of development. It is not only that they begin to develop and assume processes at an earlier period than the cells of the other groups, but the greater portion, if not all, of them appear almost simultaneously, and maintain an equal rate of growth during development. It may be expected, therefore, that this group will regulate the fundamental actions or those which are carried on in a reflex manner, and which are in great measure independent of the cephalic ganglia. In this connection the intercostal muscles, the diaphragm, abdominal muscles, and the muscles constituting the floor of the pelvis will immediately suggest themselves."

There are certain areas in the gray matter of the fore-brain of man whence proceed, it is now generally held, stimuli to the most important groups of voluntary muscles. In one of these regions are the centres which control the different groups of muscles of the upper extremity; and for the sake of simplicity we may consider that the centres of the muscles which move the shoulder, elbow, wrist, and fingers lie near to and are connected with one another. The actions of the shoulder and elbow are fundamental and well organized in the infant, as compared with those of the wrist and fingers, which are accessory and later acquired. In order that the action of the different segments of the fore-limb should be properly co-ordinated as to time, force, direction, and degree, their motor centres must habitually discharge their stimuli in due sequence and degree. Experiments on young puppies show that their motor areas are not sufficiently developed until they are ten days old for them to make voluntary movements with their limbs. Ferrier declares that "the degree of development and control which a puppy reaches in ten days or a fortnight is not attained by the human infant under a year or more." The infant, through the growth and development of the appropriate accessory centres, first gains co-ordinative control over its foot and leg, then over its arm and hand, and later over tongue and lips. It is evident that the arms of a blacksmith and those of a five-year-old boy and of an infant differ greatly as regards size, strength, and skill; but the differences which exist between them reside in the nervous mechanisms which represent the movements of which their respective muscles are capable, rather than in the muscles themselves. Not only are the motor nerves of the blacksmith the largest, but the cells in the motor areas of his brain and spinal cord are also more numerous, larger, more branched, and more widely connected with other cells. Exercise plays, if not the predominant, at least a very considerable, part in producing this result. The effects of

exercise are at once seen if one compares the right and left arms of the average blacksmith with one another. It is well known that the centres which control the right hand are situated in the cortex or outer layer of gray matter of certain portions of the left fore-brain, and that those which control the left hand are in the right fore-brain. Flechsig, who has made exhaustive studies as to the course and number of the motor-fibres which connect the muscles of the two extremities with their respective main centres, is quoted as saying that the number of fibres going to the right hand is to the number of fibres going to the left hand as three to two.

The fact that cerebral action is a large factor in voluntary muscular movements has been strikingly stated by Foster. "It is clear," he says, "that, admitting the pyramidal tract to be the ordinary channel by which volitional impulses pass to, or by which the will gains access to, the motor mechanisms immediately associated with the anterior roots of this or that spinal nerve, we must also admit that those volitional impulses passing along the pyramidal tract, or at least some of the processes constituting the will, are in connection with, and thus influenced by, the condition of other parts of the brain. When, for instance, a gymnast executes a skilled voluntary movement, in which all his four limbs and other parts, as well, perhaps, of his body, are involved, it is probably the case that changes of the nature of efferent impulses sweep down his pyramidal tract, and that these impulses, starting in a definite order from his cortex—that is to say, having undergone a certain amount of initial co-ordination at their very origin—meet with further co-ordination in the spinal gray matter, which serves as a set of nuclei of origin for the motor nerves concerned in the movement, before they issue as ordinary motor impulses along the anterior roots. But this is not all. Should the gymnast's semicircular canals happen to be injured, and his cerebrum thereby be troubled, or mischief fall on some other part of the brain which like this has no direct connection with either the pyramidal tract or the motor cortex, the movement fails through lack of co-ordination, though both the cortex, the pyramidal tract, and the spinal-motor mechanism remain as they were before. Obviously, the carrying out of a voluntary movement is a very complex proceeding, and the motor cortex with the pyramidal tract is only one part of the whole mechanism: so far from the whole business being confined to these, it is perhaps no exaggeration to say that in each movement of the kind most parts of the whole brain have a greater or less share."

The mere disuse of a muscle causes it to diminish in size. The most extreme forms of muscular atrophy and paralysis are due to diseased conditions which originate in nerve-centres or nerve-fibres. Lesions in the central nervous system may cause the bones to atrophy,

as well as the muscles. The development of a group of muscles of an entire limb, or of one side of the body, may be arrested by reason of certain forms of central nervous disease which occur in infancy and childhood. Observations made upon the brains of persons born with an arm or hand lacking, taken in connection with observations made on the brains of those who have had a hand or arm amputated, go to prove that the suppression or considerable diminution of certain movements brings about a condition of atrophy or arrested development, as the case may be, in those centres which would normally represent such movements. One may attain to the stature and semblance of manhood, and yet, through the arrested development of certain of his motor centres, be nothing better than an infant or a mere animal as regards his powers of action; while paralysis and atrophy may reduce a man, stage by stage, to the condition of an untrained child or of a helpless idiot, or even to that of a living corpse.

The functional improvement of the nervous mechanism which represents any movement, whether it be simple or complicated, automatic, reflex, or voluntary, is then to be considered as the most important effect of muscular exercise. It is not altogether clear just how it comes about that through trial and repetition an action, which is at first a difficult feat, becomes a pleasurable accomplishment, then a routine performance, and at last an almost instinctive act. But there is a settled conviction, among those who know most about both healthy and diseased nerves, that the frequent or habitual passage of stimuli from a given group of cells through definite fibres to the muscles concerned in a given movement leads to some kind of rearrangement of the molecules composing the irritable protoplasm of fibres and cells, so that less and less resistance is offered to the passage of subsequent impulses from the same source. Somehow or other, the memory of past actions and the stimuli which evoked them becomes imbedded or organized in the centres of the motor areas. The principles of physical training, whatever its end and aim may be, are based upon the power of the nervous system to receive impressions and register them or their effects; or, in other words, upon its ability to memorize the part it plays in acquired movements, and on occasion to recall and revive such movements. His once too vividly impressed sensory centres cause the burnt child to dread flame; and the difficulty of interesting an old dog in new tricks, except so far as he delights to criticise and decry them, arises from the preoccupation of his centres by old impressions rather than from their increasing insusceptibility to fresh ones.

From careful studies made as to the character of the dreams of the blind it appears that the memory of visual objects is not organized until between the fifth and seventh year of life. Persons born blind do not dream of objects in the outer world, and those who become blind before

attaining their fifth year do not dream of objects seen by them before their loss of sight. They are blind-minded as well as blind-eyed as regards such objects. There are authentic cases recorded of persons whose memory of objects, seen before the access of their blindness, persisted for twenty, thirty, and even fifty years. Then the record of their visual impressions became effaced, and they ceased to dream of objects in the outer world. The case of a man born without either hands or feet is in point here. Although he had eyesight, he did not dream of executing hand or foot movements, yet he had sufficient use of his stumps to write what is termed a good hand. There was no record of hand or foot movements in the centres which ordinarily control such movements, so that he was unable to dream of movements which he had never executed. On the other hand, the instances are very numerous in which men who have lost a limb by amputation could feel their fingers or toes while awake, and dream in sleep, or when awake, of making complicated movements with their lost members. "Persons who have had an arm amputated," says Dr. S. Weir Mitchell, "are frequently able to will a movement of the hand, and apparently to execute it to a greater or less extent. A small number have entire and painless freedom as regards all parts of the hand." They must be blind-minded, indeed, who can deny in the face of such facts that muscular movements play an important part in the development of brain-power.

Mercier, an English alienist, in his *The Nervous System and the Mind*, published in 1888, devotes much space to an ingenious and suggestive discussion of the nature of bodily movements, and their relations to the structure and functions of the nervous system; his point of view being that "the only way to get at a knowledge of the intimate arrangement of nerve-centres is by a systematic study of the movements which they actuate, and which derive their character from the mode in which the centres are arranged." Mercier bases his attempt "to organize into knowledge the facts concerning the nervous system" upon the well-known doctrines of Herbert Spencer and Hughlings Jackson, with which doctrines Ross is in general accord. But Mercier makes little use of the embryological point of view, in accordance with which Ross classifies movements as fundamental or accessory. Mercier's central and peripheral movements are approximately identical respectively with the fundamental and accessory movements of Ross, central movements being those of the trunk, shoulder, or hips, and peripheral movements being those of the digits, mouth, and eyes. Among typical central movements are included those concerned in walking, riding, swimming, rowing, bicycling, and the various feats of gymnastics; while typical peripheral movements are those involved in writing, watchmaking, piano- and violin-playing, and sewing. Intermediate movements are characterized as "more central" or "more peripheral." A "more

peripheral movement" is not necessarily, though it may be, a movement of a point farther from the trunk. It always means a movement less closely associated with the great trunk system, and one involving the action of more individualized muscles. A movement means "any set of co-ordinated muscular actions." Central movements are "*tonic* in character, those of the other (class) approximately *clonic*." Central movements are represented in the cerebrum—peripheral movements in the cerebellum.

Mercier concludes that "central movements are continuous in duration, vague in limitation, few in number, the same in character, and form a general, approximate, or coarse adjustment; that progress toward the periphery brings us to movements that are more intermittent in duration, more precisely defined, more numerous, more diversified, and more specially adjusted to particular ends; and that at the eyes, the articulatory apparatus, and the digits, where we reach the extreme periphery, all these characters reach their highest degree of development."

Having called attention to the facts that the character and efficiency of movements differ according as they are associated with other movements with which they are coincident in time, or with which they are related as parts in a series, Mercier forms two other great classes of movements—viz. "those that are combined with other movements with which they are simultaneous, and those that are combined with other movements in sequence." "It is extremely significant," he adds, "that this division coincides with the other division already considered, those movements which are combined (co-ordinated) in simultaneity being mainly *central*, while those which are co-ordinated in succession are predominantly *peripheral*. . . . . Co-ordination in simultaneity affects the central movements first, and next spreads toward the periphery, and affects the most peripheral movements last and least. Co-ordination in succession involves the most peripheral parts most often and in the most prolonged and complex sequences; and when, as often happens, the succession begins centrally and spreads to the periphery, it is the most peripheral movements to which all the others are subservient and act as aids and adjustments.

"Co-ordination of movements in succession is effected in the cerebrum, and co-ordination of movements in simultaneity in the cerebellum. . . . . Spasm due to lesion of the cerebellum is in all respects the antithesis of Jacksonian epilepsy. In Jacksonian epilepsy the spasm begins at the extreme periphery, at the lips, fingers, or toes. Cerebellar spasm begins in the most central muscles. It produces, first, opisthotonos and retraction of the head. Jacksonian epilepsy spreads centripetally up the limbs of the trunk. Cerebellar spasm spreads centrifugally from the trunk down the limbs. In Jacksonian epilepsy the spasm is always clonic. It is always jerky, intermittent,

coming on in sudden paroxysms, interrupted by periods of complete absence. Cerebellar spasm is continuous (tonic).

"Thus we find that the functions of the cerebrum and cerebellum are antithetical and complementary to one another. The cerebellum represents, first and most, the most central muscles, and the intensity of representation decreases toward the periphery. The cerebrum represents, first and most, the most peripheral muscles, and the intensity of representation diminishes toward the centre. The cerebellum maintains a continuous same action; the cerebrum breaks up the continuous same action into interrupted and various movements. The cerebellum actuates co-ordinations in simultaneity; the cerebrum actuates co-ordinations in succession. The cerebellum regulates co-ordinations in space; the cerebrum regulates co-ordinations in time."

"The muscles not only," says Sir James Crichton-Browne, the eminent English alienist, "by the locomotion which they render possible enormously widen the field from which our sense-impressions are gathered, but also, by the experiences which their own activities involve, expand our mental resources a thousand-fold. An analysis of our ideas at once reveals to us that we have few that are of purely sensory origin: our ideas of form are not mere revived optical impressions, which are properly limited to color, but ocular impressions combined with ideal ocular movements. Our idea of a circle is a combination of an ideal colored outline with an ideal circular sweep of the eyeballs, or it may be of the tactile impressions coinciding with an ideal circumduction of the arm or hand, or perhaps both these factors combined. And so it is with our ideas of weight, distance, and resistance, which all involve sensory and motor factors; and to revive in memory any such ideas is to revive both the sensory and motor elements of their composition, and to repeat definitely in certain nerve-centres the processes which correspond with certain motor acts.

"Now, the centres of motor ideation require to be exercised in order that they may be properly developed, and may contribute usefully to mental processes; and hence muscular training is likely to assume a more important and precise place in our educational systems of the future than it has hitherto done.

"These facts, that cerebral centres never properly exercised do not develop, and that when once developed they are not so liable to waste on the withdrawal of their appropriate stimuli or when they are cut off from their natural activities, strongly inculcate the importance of educating every centre at its nascent period, and the danger of postponing education till the nascent period is over. A large district of the brain is made up of motor centres and is concerned in motor ideas. The growth of that district is evidently to some extent dependent on muscular exercise, and if that is withheld at the growth-period, the

development of that district is arrested. It is not only so, but that district is made up of a series of centres in relation with different groups of muscles, and each centre is dependent for its development upon the activity of its own group of muscles; and the defective exercise of any group of muscles during the growth-period of its own particular centre (the growth-periods in most of the motor centres having different starting-points) will result in the dwarfing of that centre, and a corresponding hiatus or a general weakness must exist in the whole mental fabric.

"From this we might deduce that swaddling-bands so applied at birth as to restrain all muscular movements, and kept on during infancy and childhood, would result in idiocy—a speculation to which the wretched muscular development of most idiots and imbeciles, and the fact that their mental training is most successfully begun and carried on through muscular lessons, give some countenance. We should also have to infer that in order to build up a sound and vigorous brain we must ensure free exercise to the different groups of muscles in the order of the development of their centres, and must in no degree interfere with the natural sequence of their evolution. That being so, we must necessarily ascertain what that natural sequence is which is so important a guide to education, for in our present ignorance of it we may unwittingly be doing much mischief.

"Suppose that we are encroaching on the time at which hand-centres ought to receive their most valuable education—their nascent period—and are devoting that time to the cultivation of the tongue and lip-centres, then we should be impairing the full development of the brain; for the hand-controlling centre, if not fully exercised at its nascent period, can never afterward attain to the highest cunning. But it seems that not only tongue, but hand, and foot, and eye, and arm, and every muscle of the body, must be trained in due season if education is to do what we expect of it, and result, not in headaches and imbecilities and nervousness and insanity, but in well-balanced growth of body and mind.

"The differences which we notice between man and man in deportment, gait, and expression are but the outward and visible signs of individual variations in the development of the motor-centres of the brain; and the stammerings, grimaces, twitchings, and antics which are so common and annoying alike to those who suffer and those who witness them are probably, in many instances, the effects of neglected education of some of those centres, and might have been abolished by timely drill and discipline."

It must be evident, I think, that muscular exercise deserves more attention than is usually given it, and that, when properly chosen, regulated, and guided, it not only "does a man good," as we so often

hear it said, but makes him better; at least, it may make him a better man, in many respects, than his father was, and enable him to transmit to his progeny a veritable aptitude for better thoughts and actions. Herein lies the power of the race for self-improvement and the evolution of a higher type of man upon the earth.

"The body of the accomplished man becomes," says Bagehot in his *Physics and Politics*, "by training different from what it once was, and different from that of the rude man; it is charged with stored virtue and acquired faculty, which come away from it unceasingly. . . . . The special laws of inheritance are, indeed, yet unknown. All which is clear is that there is a tendency, a probability, greater or less according to circumstances, but always considerable, that the descendants of cultivated parents will have, by born nervous organization, a greater aptitude for cultivation than the descendants of such as are not cultivated, and that this tendency augments, in some enhanced ratio, for many generations.

"I do not think that any who do not acquire this notion of a transmitted nerve-element will ever understand 'the connective tissue' of civilization. We have here the continuous force which binds age to age, which enables each to begin with some improvement on the last, if the last did itself improve, which makes each civilization not a set of detached dots, but a line of color surely enhancing shade by shade. There is, by this doctrine, a physical cause of improvement from generation to generation, and no imagination which has apprehended it can forget it; but unless you appreciate that cause in its subtle materialism, unless you see it, as it were, playing upon the nerves of men, and, age after age, making nicer music from finer chords, you cannot comprehend the principle of inheritance either in its mystery or its power.

"These principles are quite independent of any theory as to the nature of matter or the nature of mind. They are as true upon the theory that mind acts on matter, although separate and altogether different from it, as upon the theory of Bishop Berkeley, that there is no matter, but only mind; or upon the contrary theory, that there is no mind, but only matter; or upon the yet subtler theory, now often held, that both mind and matter are different modifications of some one *tertium quid*, some hidden thing or force. All these theories admit—indeed, they are but various theories to account for the fact—that what we call matter has consequences in what we call mind, and that what we call mind produces results in what we call matter; and the doctrines I quote assume only that. Our mind, in some strange way, acts on our nerves, and our nerves store up the consequences. Somehow, the result, as a rule and commonly enough, goes down to our descendants. These primitive facts all theories admit, and all of them labor to explain."

We have seen that the effects of exercise upon a single muscle are chiefly two. On the one hand, there results a general condition which may be termed the heightened health of the neuro-muscular machine, which state of health involves the attainment and maintenance of a normal degree of size, strength, and working power in its structural parts; and on the other hand, a more complex and special effect—viz. the acquisition or organization by its neural parts of proper habits as regards the origination, transmission, and regulation of stimuli. The ends of exercise may then be characterized as the promotion of health and the acquisition of correct habits of action. The first is a hygienic end, while the second is a distinctly educational end. It matters not whether we consider a single muscle, which admits of only a single limited motion, or a group of muscles, or the communal structure we call the human body, or a class of school-children, or a regiment of soldiers: the ends of exercise in each case are the same, and can only be attained by a combination of hygienic and educational measures.

The main field of education is, then, the nervous system, and the especial province of physical training is found in its accessory portions. The principles of all forms of physical training, however various and divergent their special ends may be, are based upon the power of the nervous system to receive impressions and register them or their effects; in other words, upon its ability to memorize the part it has played in acquired movements, and on occasions to recall and revive such movements.

It is coming to be clearly recognized that the function of our public and preparatory schools and colleges is not to fit their scholars to engage as specialists in either intellectual, commercial, or industrial pursuits. The same rule holds good as to the kind, or rather degree, of physical training which should be aimed at in our schools and colleges. It is not their business to train up ball-players, carpenters, clerks, or professionals of any kind. General bodily training is the kind demanded; but training so general that it is vaguely or spasmodically or half-heartedly carried out, or, worse still, that is left to run itself in accordance with the whim or frenzy of the persons to be trained, will surely and deservedly fall short of success. Intelligence, system, organization, funds, and patience are just as imperatively required in physical training as in the training of engineers, musicians, or philologians.

The law of the evolution of the nervous system seems to me to furnish a sufficient criterion by which to estimate the worth or success of any scheme or system of physical training. Any system that does not provide first of all and continuously for the training and exercise of the central or fundamental groups of muscles will fail utterly in securing either the hygienic or the educational end of exercise; and

any system which substitutes training of the accessory neuro-muscular mechanisms for that of the fundamental ones, or which exacts undue work of undeveloped accessory centres, or attempts their training out of the proper order of their ripening, is bound to contribute more toward the promotion of brain-forcing than toward its prevention.

The most fundamental mechanisms of the trunk are those which are concerned in the movements of respiration and of circulation. They are quite fully organized at birth, but the need for their exercise ceases only with the life of the organism. The centres which represent the muscles by means of which the trunk is kept erect and balanced upon the pelvis are accessory if compared with those mentioned above, but are fundamental as compared with those which represent the muscles of locomotion. The muscles of the trunk are called into fuller and more frequent play as soon as the child ceases to go on all-fours, and it must then learn, after a fashion which may exigently demand correction or further training later on, to co-ordinate the movements of its limbs with those of its trunk. The child learns to flex its thigh upon the body, the leg upon the thigh, and to elevate the heel from the ground considerably earlier than it can raise its toes so that the foot shall swing clear of the ground and it be enabled to begin another step. What folly it would be to try to teach a toddling infant to run or jump or dance!

Similarly, the training of the hand and fingers should not only be preceded, but accompanied, by the exercise of the muscles of the forearm, arm, shoulder, and trunk. You shall not gather ripe manual cunning from a limb whose trunk attachments are undersized, untrained, or deformed. This fact points to the danger of exacting genuine manual training from young pupils, especially if it be divorced from its proper adjuvant and corrective general gymnastics. It is simply impossible to make any technical drill, such as wood-turning, penmanship, singing, piano exercises, or even the manual of arms, meet the proper ends of bodily education either for children, adolescents, or adults. Technical training, appealing as it does to the most accessory mechanisms, should be grounded on general hygienic and educational training, should not be pushed at too early a stage, and should be left, where it belongs, in the hands of special trainers.

Pastimes, out-of-door sports, and systematic gymnastics are the forms of exercise which yield the best results in the physical training of school-children and college-students. The plays of the kindergarten, the athletic sports to which British and American youth are so devoted, and the systematic gymnastics of the Swedes and Germans have all developed from one germ—from healthful play: the vital energy of this germ is found in the universal and ineradicable impulse of all healthy children to play. The children of every generation, no

matter how prim or sour or ascetic their parents may be, are always playing animals. That it is so is a most fortunate thing for the race: were it not so the victims of war, pestilence, and education, and of that voracious monster that men call business, would be vastly more numerous than they are.

In the athletic sports of young men we see the highest and fullest expression of the play instinct. The essential difference between athletics and gymnastics is one of aim. The aim of athletics, unless of the illegitimate professional sort, is pleasurable activity for the sake of recreation; that of gymnastics is discipline or training for pleasure, health, and skill. We have but to compare the aims, methods, and results of each, and to call to mind the characteristics of the nations which have affected athletics on the one hand and gymnastics on the other, to perceive that gymnastics are more highly developed and present more features of educational value. Gymnastics, as compared with athletics, are more comprehensive in their aims, more formal, elaborate, and systematic in their methods, and are productive of more solid and considerable results. Gymnastics have been most popular and general among the most highly-trained nations, such as the Greeks of old and the Germans of to-day. The most athletic and, at the same time, one of the most ill-trained of modern nations is the British. I mean simply this, that an Englishman believes, and acts upon the belief, that you come to do a thing right by doing it, and not by first learning to do it right and then doing it; whereas, the Germans leave little or nothing to the rule of thumb, not even in bodily education. German gymnastics embrace three well-marked fields or departments —viz. popular gymnastics, school gymnastics, and military gymnastics. The organization of the last two departments is maintained and controlled by the government for strictly educational purposes; while the Turn Vereine, as the popular gymnastic societies are called, are voluntary associations of a social and semi-educational, but wholly popular and patriotic, character. The fondness of the German people for gymnastics is almost as marked a national trait as is the liking of the British for athletic sports. The German system of gymnastics has been most highly developed in Prussia, where not far from a fifth of the population is undergoing systematic physical training at the present time under the combined agencies of the schools, the army, and the Turn Vereine. In Switzerland and in Norway and Sweden you will find school and military gymnastics, especially in Sweden, quite as fully developed as in Germany, and popular gymnastics not so much so.

I have no disposition to disparage athletic sports. I would that they were more general and better regulated than they are in our country. I believe that they are valuable as a means of recreation; that they conduce to bodily growth and improvement; and that their moral

effects are of value, since they call for self-subordination, public spirit, and co-operative effort, and serve to reveal the dominant characteristics and tendencies as regards the temper, disposition, and force of will of those who engage in them. But they bear so indelibly the marks of their childish origin, they are so crude and unspecialized as to their methods, as to render them inadequate for the purposes of a thorough-going and broad system of bodily education. It is well to promote them, and it is becoming increasingly necessary to regulate them, but it is unwise and short-sighted to consider them as constituting anything more than a single stage in the best bodily training.

One of the main defects of our school-training hitherto is found in the fact that lessons and tasks are set which involve the activity of the accessory parts of the nervous system before its fundamental portions have been properly built up and trained. The result of this inverted and unnatural order of teaching is seen in myriad forms of nervous disease which find expression in St. Vitus's dance, grimaces, spasms, convulsions, and other forms of disordered muscular action, as well as in the protean forms of headache, nervous exhaustion, and mental derangement so common nowadays amongst sedentary people and brain-workers. For the purpose of forestalling such results I would encourage games for boys and girls during their school-life, and would require of them compulsory attendance upon instruction in gymnastics, drawing and modelling, and in the elements of certain selected handicrafts for general educational purposes.

Dr. Ross, in his work before cited, has expressed himself so admirably with regard to the place of physical training in the education of children with neurotic tendencies that I quote his words in full:

"The children of parents who manifest a predisposition to severe nervous disease, as hysteria and epilepsy, are frequently not merely quick in their perceptive faculties, but are also often possessed of great intellectual powers, and much of their future happiness depends upon judicious mental training in youth. The children of such families ought not to be subjected to any severe mental strain during the period of bodily development, or be allowed to enter into competition with other children in the mental gymnastics which are so fashionable in our public schools. On the other hand, regular, graduated, and systematic exercise in the form of walking, riding, gymnastics, and calisthenics does a great deal of good by strengthening both the muscular and nervous system. Everything which tends to develop the muscles of the lower extremities and trunk, and indeed all muscles engaged in executing the movements common to both man and the lower animals, tends also to develop the fundamental part of the nervous system; and a good sound development of the fundamental is the first prerequisite to a well-balanced development of the accessory portion.

"The order of the development of the nervous system in the race has been from the fundamental to the accessory portions; and no one can reverse this process with impunity in that further development of the individual which constitutes education in its widest sense. Yet until a few years ago the natural order of development was reversed in the education of youth, and especially in female education, so far as this could be accomplished by human contrivance and ingenuity. The natural order of development was indeed observed so far as to allow the child to acquire the power of walking prior to that of other accomplishments, but the care of the infant had not yet been transferred to the professional trainer. No sooner, however, had what is technically called education begun than the professional trainer began to exercise the small muscles of vocalization and articulation so as to acquire the art of reading, the small muscles of the hand so as to acquire the art of writing, and in the case of young ladies the still more complicated movements necessary in running over the keyboard of a piano, while little attention was paid to the development of the larger muscles of the trunk and lower extremities, upon the full development of which the future comfort of the individual depends.

"In the education of youth in the present day the laws of development and physiology are not so openly violated and defied as they were a few years ago; but much remains to be done in this respect, and especially in the education of the children of families who manifest a neuropathic tendency. In the children of such families the greatest possible care should be taken to develop the fundamental actions, inasmuch as a sound development of these involves a stable construction of the fundamental part of the nervous system—a process which makes the latter to offer greater specific resistance to the paroxysmal discharges from the later-evolved centres of the accessory portions which underlie hysteria, epilepsy, and even many of the psychoses. The process of educating the accessory system, and especially the higher centres of that system, in young people with a neuropathic predisposition should be regular and systematic; habits of mental scrutiny and self-examination—which, unfortunately, too many religious teachers deem necessary for the welfare of the soul—ought to be discouraged. In one word, education should be made as concrete and objective as possible."

My plea is, that inasmuch as physical training enters of necessity into the training of every school-child, every apprentice, every recruit, those who undertake to train scholars or craftsmen, artists or authors, should see to it that mental training is not pursued to the neglect or detriment of bodily training; that each kind of training should be given its proper place in the compulsory curriculum of our public

schools; and that bodily training should be given in appropriately fitted places, by specially trained and well-qualified teachers, in a systematic, well-ordered, and rational way.

No comprehensive system of physical training can be considered safe or rational whose exercises are not adapted to meet the varied and varying wants and requirements of the individuals to be trained in respect to their sex, age, health, strength, mental capacity, and calling in life. The results which should be secured by such a system are briefly these: Easy and graceful carriage of the head and limbs; a broad, deep, and capacious chest in which the heart and lungs, developed to their normal size and strength, shall have free, full, and regular play; square shoulders; a straight back; fully-developed and well-rounded limbs; and the power to execute with ease, precision, and economy of force such movements as are involved in the simpler exercises of strength and skill and in ordinary gymnastic and athletic feats. Given sound organs, a well-knit, vigorous frame, ordinary intelligence and docility in a pupil, and your technical trainer will accomplish a hundred-fold more than he otherwise could, whether his business be to train up a professional fencer or ploughman, an actor or an acrobat, a singer or wood-carver, a penman or an elocutionist.

It is beyond question that the Grecian gymnastics and athletics affected chiefly the fundamental neuro-muscular mechanisms. The same is true of the martial exercises of the ancient Gauls and Teutons and of the popular sports of their descendants. Wrestling, running, leaping, casting the stone or hammer, tossing a beam or tree-trunk, hurling the spear, and cudgel and sword-play, are not only the most widespread, but also the most primitive and ancient, of European popular sports. Nor should ball-games be omitted from this category. Of popular sports in general we may say that they promote the more massive bodily virtues of strength, endurance, and speed, while dexterity, address, sleight-of-hand, finesse, quickness and accuracy of eye and hand require more specialized and complicated forms of exercise for their development. In other words, athletic sports are insufficient for the purpose of giving a complete training to the fundamental and accessory groups of muscles, and require to be supplemented by such drill as is afforded by the systematic gymnastics of the Swedes and Germans. For purely educational ends, no system of physical training has yet been devised which is equal to the Swedish school gymnastics. According to my observation, Swedish school-boys are better "set-up" and have their muscles under better control than either British or German school-boys.

The fact is worth noting that the question of improving and extending the scope and working of school gymnastics is now occupying the attention of the educational authorities of the principal nations of

Europe. It is the case in England, France, Germany, Denmark, Sweden, and Russia. In Denmark and France governmental commissions have for the last two or three years been engaged in framing new gymnastic codes. The new French code will be largely based on elaborate physiological studies made by M. Georges Demeny in the laboratory of Professor Marey, the eminent French physiologist. A summary account of some of Demeny's conclusions is found in an article "On Precision in Physical Education" in the *Popular Science Monthly* for February, 1891.

"Play-hours," says Demeny, "do not constitute a complete physical education. There is exercise in play-hours, but there is not, properly speaking, training of the movements in view of a useful effect. Each one does not get the portion of exercise to which he has a right. According to the general law, the strongest or most hardy are more benefited than the weaker ones, and the mean level does not rise. Games and sports are still what they always have been, an elegant means of amusement, an agreeable exercise, the privilege of the easy class, the pleasure of the smallest number."

Even in England, the stronghold of unhampered athleticism, the idea is gaining ground that the rightfully prized but overlauded out-of-door games have their limitations, and may be advantageously supplemented by gymnastics or "drilling lessons." As bearing on this point, the following extract from Dr. Francis Warner's lectures, delivered in the University of Cambridge, 1888–89, on "The Growth and Means of Training the Mental Faculty," is of interest:

"Drilling lessons have often been looked upon only as means of 'getting up the muscles,' and they have been used accordingly, with the result that, as in the case of athletics, the maximum of good has not always been attained, and harm has sometimes resulted. . . . . If the object of the physical exercises be to drill the nerve-centres, increasing the quickness and precision of their action, then the brain-centres should, as far as possible, be free to receive the word of command. We must get the attention of the class, and try to perfect the time of their actions, rather than to cause strong stimulation of the muscles. Leave the muscles free, have nothing in the hands when you wish mainly to deal with the nerve-centres; use no clubs or weights, and let the hands be open. Arrange your exercises so as to produce movements in some definite order; at the same time let them effect but little mechanical work; let the movements, following your word of command, be such as to exercise all the known physiological groups of muscular actions, the groups of muscles supplied by each cranial nerve—the eyes, face, tongue, head, and spine. In the limbs exercise muscles of the large parts and small parts, and movements of the separate digits in flexion and extension, as well as in lateral movements. Each group

of muscular actions, due to the energy of a brain-centre, may be brought into action by drilling.

"Some very beautiful exercises with balls have been used, which tend not only to regulate and quicken the effect of sight upon movement, but also to increase the power of accommodating vision as the eye follows the ball. I think that this subject of drilling the nerve-centres is well worthy of more serious attention than it has received."

Mechano-therapy has been, and still is, for the most part, employed in an empirical way. One branch of mechano-therapy—viz. massage—may now be said to constitute a part of rational therapeutics, since physiologists, pathologists, and clinicians have conjointly accumulated a sufficient body of facts to explain its working and effects, and to make clear the principles in accordance with which it should be resorted to or avoided as a remedial agent. Physiology, in its modern development, has thrown much light on the nature and uses of general muscular exercise, but until physiologists and clinicians shall have given at least as much attention to general exercise as they have to massage, muscular exercise must remain a part of empirical therapeutics, even though there be a considerable and increasing number of men who are capable of making rational use of it. The growing tendency of some of the wisest and most successful physicians to supplement the use of drugs by means of hygienic and dietetic measures is a hopeful one, and may ultimately lead to a recognition and determination of the rational uses of exercise in the treatment of disease. At the same time, it is idle and unprofitable to claim too much for, or to expect too much from, such procedures as bathing or exercise, since they are at best adjuvants only, and can never supersede the use of medicaments.

Speaking broadly, it is hardly possible to discriminate accurately between the hygienic and therapeutical effects of exercise; at any rate, when we have to do with certain general disorders, such as debility, anæmia, neurasthenia, hysteria, obesity, and insufficient muscular development. Exercise is as necessary as sufficient and nutritious food for growing children, in health, in order to secure normal growth of structure and normal development of function in the various tissues and organs. Similarly, adolescents and adults require a certain amount of muscular exercise to prevent their organs from dwindling in size and losing their full powers of functional activity. In such cases exercise, if not excessive or ill-timed, is to be considered a hygienic measure. In ill-nourished, weakly children, on the other hand, in convalescents recovering from acute or chronic illness, in many cases of brain-fag, in some forms of mental derangement, exercise may be employed as a general tonic or prophylactic.

Attention was called above to the opinions of Dr. Ross with regard

to the place of physical training in the education of children who inherit neurotic or insane tendencies. It may here be mentioned that the directors of several American asylums for the blind, for feeble-minded, for deaf-mutes, and the insane have introduced one or another form of physical training, not only as a means of promoting the health of those under their charge, but for the avowed purpose, as well, of awakening, strengthening, and refining the activities of the brain and sense-organs. Special teachers of gymnastics—and in some cases specially-erected gymnasia also—are to be found in the institutions named below: the Maryland Asylum for the Blind, in Baltimore; McLean Asylum for the Insane, Somerville, Mass.; Friends' Insane Asylum, Frankford, Pa.; the Seguin Physiological School for Feeble-minded Children, New York City; and Dr. Walter Channing's Asylum for the Insane, in Brookline, Mass. This list might doubtless be enlarged, as it was quite the fashion to adopt calisthenics and gymnastics in such institutions, chiefly as a hygienic means of recreation, about thirty years ago. M. Napoleon Laisne, a prominent and experienced teacher of gymnastics in Paris, proved some years ago, in one of the hospitals of that city, that gymnastic drill could be put to good use in the treatment of chorea.

The late Dr. E. Seguin of New York was an ardent advocate of muscular exercise as a factor in what he denominated physiological education. As is well known, he was among the first to show that idiots could be educated. In his work on *Idiocy*, Seguin gives a circumstantial account of the manner in which physical exercises were employed to awaken and confirm intelligence nearly forty years ago in the Institution for Idiots established under Dr. Wilbur at Syracuse, N. Y., in 1854. Seguin's views and experience may be cited here with profit, since they relate not only to the subject under consideration, but also afford concrete evidence in favor of the somewhat theoretical and schematic statements quoted above from Ross, Crichton-Browne, and Mercier.

In his "Report on Education" (second edition, 1880), Seguin, in speaking of English teachers of idiots, avers that "they do not seem to attach sufficient importance to that period of the education which corresponds in the idiot with what I will venture to call the *building mania* in the infancy of peoples. If we can make the pupil enter upon this period, and if we awaken that taste in him, he may be, through it, carried to the conception of higher combinations of parts to form a whole, besides acquiring, in various attitudes, operations, and manipulations of the *material*, the physical aptitudes comprehended in the word 'dexterity.'

"At the threshold of the school proper they do not seem to understand that filiation, and therefore that rational progression, which gives

precedence to the systematic movements of the body over drawing, of drawing over writing, of writing over reading; it is almost the reverse order that obtains, unless, as in the majority of instances, there is no order at all, either practised or suspected. . . . . At the bottom of success in all the arts and of all artisans is the precision of touch, which is a guide to our natural or mechanical instruments of execution. Since the muscles of the life of relation obey the nervous impulses, results of impressions either actual or previously recorded, the richer the store of sensory impressions the more true and effective will be the work done by the skilful play of the muscular contractions. . . . . But in that *touch* there is more than sensitive *tact:* there is also a force prompted by a muscular lever.

"Gymnastics and sports are instituted to develop this power; many schools have them; all should have a gymnasium; but, strange enough, hardly any one suspects its *raison-d'être.* To grow immense packs of muscles? No, but to develop parts of the body weakened or ill-nourished, to harmonize several organic and all the motor and local functions, to put the essential apparatus, as lungs, heart, skin, in working order, and to discipline every muscle of the life of relation to obey the dictates of the intellect from the brain, of the will from the sympathetic and spinal cord. This should supersede the gymnastics, boating, racing, etc. instituted to make muscle for the sake of muscle, producing clowns, amusing enough, colossi, achronological pachyderms, extinct knighthoods which cannot show on their blazon one noble though comical Don Quixote for a hundred greasy Sancho Panzas. The gymnastics we favor and demand is that which calls into useful activity the muscles controlled by the sentient and motor nerves—every lever which can be commanded by a refined intellect; this training to be done from the periphery to the centre, from the centre to the periphery, be it imitated or willed; to develop the primary elements of intentional personal *activity* and of objective *aggressivity,* giving a meaning to every muscular contraction." So much for Seguin's views in *Physiological Education*—expressed, be it said, by means of a somewhat antiquated terminology. His article entitled, "Psycho-physiological Training of an Idiotic Hand," in the *Archives of Medicine,* October, 1879, shows how he applied his theories. The case reported is that of a boy, eight years old, rendered idiotic by infantile convulsions. The boy had been under the training detailed by Seguin for one year:

"The hand of R—— was small, the nails short and brittle, fingers as if unfinished—no power, no skill, only automatic movements, mainly from the wrist. To make R——'s hand act on command was at first out of the question. He could not put it or the fingers in any given attitude. He could obey the movements of elevation and abduction of the arm, but not always nor with anything like precision.

"*Therefore his teacher had to begin the training of the hand from the shoulder by movements which, starting from the elevators of the arms, would involve successively the muscles of the arm and hand.* Thus, by a series of operations whose willed or obedient starting-point descended gradually from the spine, the child became capable of moving his hand and fingers by imitation, at first, and *proprio motu* for simple willed operations later. . . . . The movements commanded to R—— were those commencing nearer the spine, the trainer gradually extending the operations of the will to the groups of muscles approaching the extremities. Thus the limb in training not only became capable of a few willed movements of totality, later applicable to a great number of operations and convertible into smaller movements of the farther extremities, but the mind, being drilled to be carried over regions previously ruled by automatism alone, extended its dominions and circulated as if at home from the great centres to the most delicate groups of sensitive and contractile tissues at the periphery.

"To illustrate the difference of ability of the hand during these forms of training according to the origin of the impulse, I notice the freedom of the hand of R—— when driving nails in a board with a hammer—a movement of the arm and wrist—as against the sliding of a pin he holds with the intention of piercing holes in a paper, with but rare success—movement confined to the last phalanges of two fingers.

"Has he learned to read, write, and the sequel? No: his hand has learned to help himself, to amuse himself, to not bite itself, nor to slap his friends, though it is yet sometimes subject to its automatic agitations. His tact has been cultivated to the point of being conscious of the ordinary variations of the temperature, of water, food, etc., and of recognizing and naming (without the help of sight) about fifty things by their shape, and quite as many by their texture. His eye—after his touch—has been drilled to appreciate the typical forms in substance at first, and later painted, delineated, and hardly indicated; then to cut the same out of paper, etc."

The following year much attention was given to training R——'s eyes in correlation with his hands, and as a result of the training initiated in the education of his hand, above detailed, R—— was finally enabled to enter a school for ordinary children, and to do fairly well at his lessons.

Although systematic exercise has been accorded for many years a prominent place in the course of treatment and training of institutions for defectives in various European countries, notably Germany and Sweden, it is to an American institution, the New York State Reformatory, at Elmira, N. Y., that we owe the proof of the efficacy of physical training as a helpful means of reforming felons. In many

respects the Elmira Reformatory, founded in 1876, is perhaps the most original educational institution in America. Its inmates consist of male felons between sixteen and thirty years of age, serving their first sentence. All sentences to Elmira are indeterminate—that is to say, no prisoner may be confined for a period exceeding the maximum term of imprisonment provided by law for the crime of which he has been convicted. But it is possible for a prisoner to gain an absolute release in about eighteen months from the time of entering the reformatory, though he may have been convicted of a crime punishable under ordinary circumstances with imprisonment for a term of years. To accomplish this is no easy task, for the conditions of release, which is always on parole for six months at least in the first instance, are—that the inmate shall earn perfect marks for twelve consecutive months in "conduct," "labor," and "school;" that he must gain the confidence of the general superintendent and managers; and that previously to his release "some definite, permanent, suitable employment" shall be arranged for by his friends or the management of the reformatory. If a paroled prisoner gives satisfaction to his employer and the authorities of the reformatory during the period of his parole, he may then secure his absolute release and return to civil life without loss of citizenship. 9 is a perfect mark for a month; failure to earn a 3 in either conduct, labor, or school-work entails a new start, as no one is admitted to parole who has not twelve consecutive 9's to his credit. Of the 4550 prisoners received up to September 30, 1890, the number paroled was 2611. It is claimed that about 70 per cent. of those who have been released from the reformatory have not relapsed into crime. The average detention before parole was twenty-one months.

In June, 1886, at the suggestion of Superintendent Brockway, Dr. H. D. Wey, the physician of the reformatory, formed an "experimental class in physical culture." The class was composed of dullards who for a year or more made had no appreciable progress in their school-work, and were likewise behindhand in their labor-tasks. The object of the formation of the class was "to ascertain if physical culture, as comprised in frequent baths, massage, and daily calisthenics, would not result in a partial awakening and stimulation of dormant mental power. Increased mental activity, rather than muscular development, was to be the gauge of the success or failure of the experiment." Eleven men, ranging from nineteen to twenty-nine years of age, were subjected to the conditions spoken of above. They were released from shop-work during that period, but were carefully schooled. The course of procedure finally adopted was to give the class two hours or slightly more a day of practice in "setting-up" exercises and in a dumb-bell drill, and each man had three baths a week, followed by "bath-massage." The members of this class were not sickly, ill-

nourished specimens, nor could they be classed with those who are technically termed weak-minded: they were simply coarse, stupid, insensitive, unambitious dullards imprisoned for felony.

The five months' experiment proved a striking success. The men improved not only in physique and carriage, but also in mental power and self-control. The average marking of the class, according to the school register, was, for the five months in question, 74.16 out of a possible 100, whereas the corresponding mark, for the five months immediately prior to the beginning of the experiment, was 45.25. Comparison of the record of the class for the six months preceding the five months of physical training with its record for the six months succeeding that period shows that the improvement gained was not of a transitory character. In the first period the general average on the scale of 100 was 46, and in the second 71; while the average marks, 3 being the scale in conduct, were—$2\frac{1}{2}$ and $2\frac{1}{3}$ respectively, and in school-work $1\frac{3}{2}\frac{}{2}$ and $2\frac{9}{3}\frac{}{0}$ respectively.

Owing to the successful results obtained by Dr. Wey in the case of the experimental class, and of several subsequent classes subjected to similar treatment, the New York Legislature appropriated funds sufficient to provide the Elmira Reformatory with a suitable gymnasium and bath-house. These establishments, costing when completed about $15,000, have been in use since March 20, 1890. The two establishments are included in one building. The gymnasium hall, which is 83 by 102 feet, has a suspended running track, and is fully furnished with apparatus, including a set of Dr. Sargent's developing gymnastic machines. The bath-house contains two "hot rooms," a massage-room, and a swiming bath 16 by 45 feet. The main portion of the inmates at Elmira are not subjected to gymnastic training; they are, however, organized as a regiment, are subject to military regulations, and are regularly and strictly exercised in military drill.

"The gymnasium," says Dr. Wey in the report of the reformatory for 1890, "has come to be, for certain classes of defectives, a place of preparation for the schools of trades and letters, and *an auxiliary to the hospital.* 128 men have received treatment in the gymnasium. Of this number, 43 comprised a class in training at the time the building was completed, and the balance, 85, were subsequently selected [out of a total of 1080 inmates]. The 85 men were placed in training for the following purposes:

"1. Physical renovation and betterment, 63.

"2. Intellection, 14.

"3. Ethics, 8.

"The first class comprised boys who were received into the reformatory poorly nourished and anæmic; those reduced through personal vices and physical disturbances incident to puberty; the shop-worn

and subjects of actual lesion or disease. For the first three varieties physical training is a reconstructive measure. For the third variety, subjects of certain lesions, an improved nutrition, resulting from increased powers of assimilation and waste, operates more favorably than hospital care and chemical therapeutics. Selections have been made for functional cardiac trouble due to nervous enervation, subacute bronchitis, epilepsy, struma, incipient pulmonary disease, and cutaneous affections, as acne, seborrhœa, and ichthyosis.

"The effect upon the dullard of the bath, exercise, and dietetics quickens and widens the scope of motor and sensory functions, draws out latent energy, and establishes a degree of susceptibility to class-room influences. Thus, qualities of cerebration become reasonably certain that were possible, but not probable, during a continuance of the subject's vegetative state.

"Those selected for ethical improvement were instances of low and faulty bodily conditions operating to the detriment of order and behavior."

The Elmira gymnasium is not due to an attack of what Dr. Seguin happily styles the *building mania*. It owes its existence to a firm conviction, born of experiment and reflection, that systematic muscular exercise is capable of building up and strengthening the brain and nerves, as well as the organs of locomotion, nutrition, and excretion. It is devoutly to be desired that a tithe of the American schools and colleges that have fallen in with the present fashion of building gymnasia should profit by the example of Elmira, and order and administer their departments of physical training in accordance with sound hygienic and pedagogical principles. Not a few college presidents and boards of trust have suffered from acute attacks of what may be termed *Pruritus ædificandi*, but the instances are extremely rare in which they have shown any symptoms of *Furor pedagogicus*, so far as physical education is concerned.

Dr. Wey's assertion that the Elmira gymnasium is an efficient auxiliary to the prison hospital is worthy of careful consideration on the part of the governors of our large general hospitals. As has been mentioned, many institutions for defectives have adopted gymnastic procedures as a part of their course of treatment and training, and a considerable number of private orthopædic institutes, having more or less complete gymnasia, might be added to the list. But I have yet to learn of any large general hospital, either in this country or in Europe, which numbers among its resources a well-equipped general or medical gymnasium. It seems to me high time that those in charge of medical schools, public hospitals, and dispensaries should give serious attention to mechano-therapy in all its branches; should test the worth of the appliances and methods now in use in this field; and should adopt and

employ such of them as may stand the test of critical study and well-directed experiment.

Medical gymnastics and massage have been left so generally, especially in this country and Great Britain, in the hands of uncritical and enthusiastic laymen, or of quacks and humbugs, that mechano-therapy is not likely to receive its due meed of recognition, from the profession at large, until some few at least of those who mould medical opinion through their didactic and clinical teachings shall have determined and set forth the actual value of mechano-therapeutical procedures and their proper relations to chemical therapeutics.

It seems a misfortune, or worse, that the profession is as yet unprepared or unwilling to speak with authority on the uses and abuses of exercise. There is already a demand for rational advice in this matter, and that demand is increasing by reason of the rapid spread of ill-regulated forms of violent exercise in school and college circles, the rapid multiplication of gymnasia and athletic clubs, and the growing agitation for the introduction of physical and manual training into the public-school curriculum. While the market is wellnigh flooded with books and articles by untrained "professors" and uncritical visionaries upon "massage," "relaxing exercises," "Delsarte exercises," "rest cures," and other fragmentary and aberrant systems of physical exercise, there exists no complete and satisfactory treatise, in English, upon the nature and effects of exercise, and the laws by which it should be regulated when employed for hygienic, educational, or remedial ends. The works of Dr. Fernand Lagrange of France and Dr. Roth of London cover the ground in a partial way only. It would seem that the public must follow for the most part misleading or false guides, so long as medical teachers and writers fail to treat the subject in a thorough-going, scientific, and practical way.

Of national systems of exercise, only the Grecian and the Swedish present a distinct department of medical gymnastics. Grecian medical gymnastics are chiefly of historical interest, as modern therapeutics have been in no wise moulded by the teachings of Herodicus, Hippocrates, and Galen with regard to dietetic exercise. We need not concern ourselves here with the mechano-therapy of the Greeks and Romans, or that of the Hindoos and Chinese, as the gymnastics and massage now in vogue are essentially products of the nineteenth century, though it is possible to show that they were matters of speculation and experiment in France, Germany, and England during the second half of the last century.

Modern gymnastics have reached their highest development in Sweden and Germany, where for some scores of years they have been systematically employed for purposes of school and military training; but the Swedish *Sjukgymnastik*, or movement treatment, is as distinctly

superior for medical purposes to the German *Turnen* as it is to the school games of the English. Swedish gymnastics were first quickened and shaped through the instrumentality of Peter Henry Ling, a Swede, who was born in 1776 and died in 1839. It is said that Ling's interest in gymnastics arose from his having been cured, while a student, of a rheumatic affection in the shoulder through the practice of fencing. He began his public career in 1804 as a teacher of gymnastics and fencing at the Swedish University of Lund. Ling was unquestionably a man of genius. and became renowned not only as the founder of Swedish gymnastics, but as a linguist and poet as well. From the time of its establishment in 1813 until his death Ling was at the head of the Royal Central Gymnastic Institute at Stockholm. Ling, though an ardent student of the anatomy and physiology of his day, never had a medical degree. He seems to have been an acute observer, an indefatigable worker, and an inspiring teacher. He and his pupils succeeded in gaining a large measure of approval and patronage from the public, in spite of the indifference or hostility of the medical profession. Early in his career Ling attracted the attention of Bernadotte, whose friendship and patronage proved of great service to him and his cause.

Ling divided gymnastic movements into four main classes—viz. 1, movements serviceable in the treatment of disease or deformity, or *Sjukgymnastik;* 2, movements chiefly useful in promoting and maintaining a normal bodily development, or *Friskgymnastik;* 3, movements suited to rendering recruits in the army and navy strong, dextrous, and enduring, or *Militärgymnastik;* and 4, movements for giving outward expression to thought or motion, or *Aestetiskgymnastik.* It is a cardinal principle in all forms of the Swedish gymnastics that any given movement of the trunk or limbs has a specific effect upon the inner organs of the body, and that in medical and developing exercises only such movements should be employed as have been shown by experience to produce the effect desired. Great care in selecting movements and strict regard to the manner in which they should be performed characterize the Swedish gymnastics.

Although many of the doctrines enunciated by Ling and his successors at the Central Institute in Stockholm seem mystical and fantastic in the light of modern physiological and medical science, they are entitled to a high meed of praise for their success in proving the practical worth of methodical muscular exercise as a means to reaching certain educational, hygienic, and remedial ends.

The procedures employed by the medical gymnasts comprise active movements, which are simply voluntary movements executed by the patient without assistance; passive movements, or movements of the patient's body or of some part of it by the manipulator; and duplex

movements, in which both patient and gymnast take part. Resisted and assisted movements, of which so much is said in massage literature, belong to the so-called duplex movements. The use of passive and duplex movements is one of the most characteristic features of the Swedish-movement treatment. According to a recent law—whose provisions are not retroactive, however—only such persons as pass the examinations set by the Central Institute in Stockholm or by a duly authorized government board will be licensed to practise medical gymnastics, and unless they possess a medical degree they must associate themselves with a physician or act under the direction of one.

The Central Institute has become the most comprehensive and thorough gymnastic school in the world. Ling has had three successors, of whom two were physicians. Its present teaching staff numbers three physicians among its members, as well as several officers of the army, fencing being a favorite branch of instruction; indeed, the majority of its pupils are young officers of the army and navy. The course of study is three years, for women two, the latter being excused from the course in fencing. One must take the full course in order to be graduated as a Sjukgymnast, but may fulfil the requirements of the normal course for teachers of school or military gymnastics in two years. Anatomy, physiology, and the principles and practice of movements are the chief studies. Didactic teaching and practical exercises are combined in the instruction throughout the entire course. Some hundreds of school-children are taught gymnastics by the pupils of the institute. In the winter of 1888–89, I found from 100 to 150 patients a day treated solely by gymnastics in the clinics of the institute, the main purpose of the clinics being to afford the pupils of the last year practice in treating disease under the immediate guidance of their medical teachers.

Disease.	Men.	Women.	Total.	Condition when Discharged.			Still under Treatment.
				Well.	Impr'd.	Unimp'd.	
Constitutional	27	49	76	18	37	1	20
Of nervous system	56	30	86	3	38	17	28
Circulatory system	23	8	31	1	19	2	9
Respiratory organs	12	6	18	0	9	2	7
Digestive organs	48	11	59	10	26	3	20
Genito-urinary organs . .	4	3	7	0	3	2	2
Organs of locomotion . . .	56	69	125	35	44	7	39
	226	176	402	67	176	34	125

In this country we are accustomed to consider the movement treatment as suitable for orthopædic cases chiefly. The foregoing abstract of the report of patients treated at the Central Institute in 1884 may

serve to indicate the inadequacy of our notions in this regard: The total number of patients were 402, of whom 226 were males and 176 females; 29 patients were over sixty years and 7 were under ten years old. The number of patients between twenty and forty years of age was 182. The number of diseases specified is 48, grouped as above.

Of the 125 cases classed under "Diseases of the Organs of Locomotion," only 48 were of an orthopædic nature, 25 were of myositis, 13 of muscular rheumatism, and 34 of affections of the joints.

Medical gymnastics and massage are frequently used in combination in Sweden and Norway, though the distinction between the two is nowhere more clearly recognized than in those countries. Massage is understood to consist of a few peculiar manipulations, such as stroking, kneading, friction, and striking. It is frequently practised by persons, including many physicians, who are not gymnasts. The massage movements were described and made use of by Ling among his so-called passive movements, though the term massage is French and has become general in Sweden only within the last twenty years. Still, as is easily shown, Dutch, German, and Swedish physicians have been much more influential than the Swedish gymnasts in winning recognition for massage as a special mode of treatment. The peculiar combination of massage and gymnastics, known as pelvic or Brandt massage, may be cited as a partial exception to the above statement. Major Thure Brandt of Stockholm, a Swedish gymnast of high character and good standing, has employed massage and gymnastics in the treatment of prolapsus uteri, prolapsus ani, retroversio uteri, parametritis, etc. for many years. His method has attracted much attention in Germany within the last five years. Many German gynecologists have visited Stockholm for the purpose of receiving instruction from Brandt. Despite the fact of Brandt's being a layman, his method has been used in the clinics of Schulze at Jena, Von Preuschen at Greifswald, Schauta at Prague, Breisky in Vienna, and in the Vienna Polyclinic. Brandt's book, which originally appeared in 1863, has been republished in French and German, as well as in Swedish. Roth of London published a condensed English translation of it some years since. Reibmayr's *Die Unterleibs Massage* (Vienna, 1889) contains an account of Brandt's method, and cites some twenty-five titles of books and articles relating to it or cases treated according to its principles. The Brandt massage is sufficiently rational and conservative to be worthy of study and testing of American and English, as well as Scandinavian and German, gynecologists; but it cannot safely be relegated to ordinary rubbers who work by the hour.

The ordinary medical gymnast is often termed a manual gymnast, for the reason that he employs comparatively little apparatus in his practice, while such simple appliances as he does use do not come under

the head of machinery. One of the most notable forms of the Swedish gymnastics is that known as the mechanico-medical gymnastics, or the Zander gymnastics, as it is sometimes called after its inventor, Dr. Gustaf Zander of Stockholm. In the course of the last twenty-five years Dr. Zander, whose mechanical genius is of a high order, has devised fifty-eight different machines by means of which it is possible to give circumscribed and accurately regulated exercise to almost any particular group of muscles in the body. The principles and aims of the mechanical and manual gymnastics are essentially the same; but it is claimed that the former is a cheaper, more accurate, and efficacious means of procedure than the latter. In a proportion of cases the claim is doubtless just, but it is often necessary to supplement the use of the machines by the employment of a trained hand, especially in affections of the joints. The Zander system has been uncritically described and decried in some quarters as a system of mechanical massage. It is nothing of the kind. Dr. Zander distinctly disclaims having attempted to devise such a system, and has a staff of trained masseurs to give massage in cases properly calling for it. What he does claim is this: that the most important and valuable of the procedures comprised in the movement treatment can be better given by his machines than by manual means.

In the construction of his machines Dr. Zander has made use chiefly of the mechanical principle of the lever, as that is the principle of construction in most of the joints of the human body. By the ingenious use of counter-weights, and of perforated weights which may be fastened at any desired point on the arms of the lever, the resistance afforded by the machines can be accurately adjusted to the special needs of individual patients. The machines are divided into two main groups—viz. those set in motion by the muscular effort of the patient, and those run by a motor. For the latter series an engine of from six to ten horse-power is sufficient. The first group of machines are termed machines for active movements, and comprise the following series of machines: twelve for arm movements, such as flexion, extension, and twisting at the shoulder, elbow, and wrist; thirteen for similar leg movements; nine for trunk extension, flexions, and twistings; and three for trunk-balancing movements. In the second group are five machines for passive movements and thirteen for mechanical manipulations, such as shaking, chopping, rubbing, and kneading. Besides these, Dr. Zander has designed five machines for the special treatment of scoliosis, of which three are employed to counteract abnormal curvature and rotation of the spinal column by means of carefully regulated pressure, and two are used for accurate measurement of the back and thorax. For distinctly medical purposes the machines for passive movements and for mechanical manipulations are rather more service-

able than the active movement machines, which are more particularly intended for dietetic or developing gymnastics.

As is well known, Dr. Sargent of the Hemenway Gymnasium at Harvard University, has invented a series of some fifty so-called developing gymnastic machines. In the Sargent machines, which are now to be found in most of the newer gymnasiums of the United States, adjustable pulley-weights, running between metal rods as guides, are employed in a great variety of ways. Only active movements are provided for in the Sargent system, which is much better adapted to secure dietetic than medical ends. Although the Zander machines are superior in many respects to the Sargent machines, their cost is so great that their use is not likely to become general in our ordinary gymnasium. The Woman's College of Baltimore, however, has fitted its gymnasium with a nearly complete set of Zander machines for active movements, being the first institution in the United States to import them. There has been, however, for some years a complete Zander institute in Buenos Ayres, in South America. The only complete set of Zander machines in the United States is found in the Medico-Gymnastic Institute of Dr. L. Wischnewetsky in New York City, which was opened in the autumn of 1890. A full set of the machines has been purchased, however, for a projected Zander institute in Boston.

The Zander Institute and its founder stand deservedly high in the estimation of the medical profession of Stockholm, where the physicians are more inclined toward mechano-therapy than ever before. The institute was opened in 1865, and has since been in continuous operation. It is, however, open for patients only from September 20th till May 15th. It has no boarding-house, hospital, or hotel attachment. In the year 1888–89, Dr. Zander's patients numbered 619; in 1887–88, 549. The following statistical statement will afford an idea of the scope of the treatment. Patients were treated in 1887–88 as follows:

For anæmia and chlorosis	27
For obesity	13
For nervous affections	79
For heart affections	108
For diseases of the lungs	11
For diseases of the digestive organs	89
For diseases of the organs of locomotion	159
Number taking dietetic gymnastics	63
	549

The success of the Swedish gymnasts, both by manual and mechanical means, in treating affections of the heart has been quite remarkable. In this branch of treatment the Swedes certainly anticipated the so-called Oertel cure for weak and fatty heart. It is so totally foreign to our ideas to prescribe or even allow gymnastics in cases of heart disease

that a closer analysis of those cases included in the above table will be of interest. Of 108 cases under heart affection, there were—

2 of angina pectoris,
27 of erethismus cordis,
52 of asthenia cordis,
20 of vitium organicum cordis,
7 of endarteritis chronica.

Dr. Zander has had marked success in treating scoliosis. He has devised an ingenious apparatus for measuring the deviations of the spinal column, and makes constant use of it in checking the results of his treatment. (For an account of Dr. Zander's methods and results see his article, "Om Den Habituela Skolioseus Behandling Medels Mekanisk Gymnastik," in *Nordiskt Mediciniskt Arkiv*, Band xxi., Nov. 22, 1889. The article is in Swedish, but is accompanied by an abstract in French.)

There are two Zander institutes in Stockholm, and one institute where a partial set of the Zander machines are employed in combination with manual gymnastics. At the Royal Central Institute and at the Orthopædic Gymnastic Institute, which has been subsidized by the Crown for many years—perhaps thirty or more—the Zander machines are not in use. Several smaller institutes belonging to private gymnasts also exist in Stockholm. It is within the mark to estimate the number of patients who are annually treated according to the principles of the movement treatment in the city of Stockholm as from 1500 to 2000; this does not include those in hospital or private practice who receive an exclusive or preponderant massage treatment. Zander institutes are also found in Upsala, Gothenburg, Norrköping, and Orebro in Sweden; in Christiana in Norway; and in Copenhagen, Denmark.

Outside of Scandinavia mechano-therapy has won recognition chiefly in Germany. This is especially true of the Zander system of gymnastics. In 1885 there were Zander institutes in St. Petersburg, Christiana, Helsingfors, and London; the only one in Germany was at Baden-Baden. Now there are Zander institutes in Berlin, Hamburg, Breslau, Wiesbaden, Frankfort, Munich, Dresden, Karlsruhe, Würzburg, Mannheim, Vienna, and Budapest. It is Dr. Zander's rule not to sell his machines to laymen. The textbook on this subject is one entitled *The Movement Treatment and Massage, with Especial Regard to the Zander System of Medical Gymnastics*, Wiesbaden, 1889. It was written by Dr. H. Nebel, formerly medical director of the Zander Institute at Hamburg, now of the Zander Institute at Frankfort. Dr. Nebel's book is of especial interest, for the reason that he reports on the major part of nearly 1500 cases treated by him in the course of two seasons at the Hamburg Institute. The report of Dr. Heiligenthal, medical director of the Grand Ducal Frederick's Bath at Baden-Baden, is worth noting. The report was published in March, 1888. The

department for mechanical health gymnastics was opened in June, 1884, with some 20 of the Zander machines. In the course of two years it was found necessary to increase their number to 73. In 1884 the number of persons who used this department of the Frederick's Bath was 115; in 1885 it was 269, and in 1887, 633. The cases treated in 1887 were classed as follows: Diseases of the nervous system, 140 (therein were included 34 cases of diseased sensory nerves, 31 of disease of motor nerves, 8 cases of writers' cramp, and 42 cases of neurasthenia); diseases of the heart and blood-vessels, 84, including 30 cases of fatty heart, 23 cases of valvular disease (13 cases of mitral insufficiency, 6 cases of insufficiency of the aortic valves), 3 cases of aneurism of the aorta, 3 cases of heart neurosis, 5 of angina pectoris, 3 of arterio-sclerosis, and 1 of varix; of chronic rheumatism there were 72 cases; of lumbago, gout, and arthritis deformans, 56 cases; of obesity, 54 cases; of general debility, 44 cases; of chronic constipation, 30 cases; and others of less interest.

Enough has been said, I think, to indicate that medical gymnastics have entered on a new stage of development—that they are more carefully studied, better understood, and more generally prescribed by medical men in Scandinavia and Germany than ever before. The average practitioner of medicine has neither time nor appliances to devote to the mechanico-therapeutical treatment of the obstinately chronic cases in which he is inclined to prescribe "muscular exercise," "out-of-door life," and other equally vague remedies. Zander institutes, under the guidance and control of regularly educated specialists, would be a help and not a hindrance to the average practitioner in all our large cities. The Zander Institute in Berlin was established by an association of physicians, and the best men of the profession send patients to it.

CLIMATE.

By S. EDWIN SOLLY, M. R. C. S., L. S. A.

THE object of the following article is to discuss the treatment of disease by climate, and not to give an exhaustive treatise on climatology, with a description of the several noted resorts and the diseases suitable for treatment in each; but rather to show the fundamental principles of the subject and the general bearing of admitted facts, which, if digested carefully beforehand or referred to when needed, will give to the general practitioner a rational basis for forming a judgment as to the kind of climate best suited to the patient upon whom he wishes to try the experiment of climatic change. The physician can then select from among the various places whose general characteristics range them in the class suitable for the case the one that from the more special information given in the handbooks appears to fulfil best the required conditions. Although it is desirable in a practical article on climatotherapy to avoid abstract questions and theories, it is nevertheless necessary, in order to reach the practical point sought for, to build up a pyramid as it were, the base being formed of physics, the next tier of physiology, upon which should be placed a layer of geographical pathology; then the main divisions of climates; above this their special divisions; upon this, again, a general description of the pathological conditions for the relief of which climatic treatment may be required—then the general therapeutical application; then the consideration of idiosyncrasy; and lastly, as its apex, the physician places his study of his individual case, and thus the practical point is rationally arrived at. As much of what is said under these various heads is familiar to many, each will be designated, so that when known they can be omitted in the reading and the conclusions earlier reached.

Climatology is the study of the characteristics of different portions of the earth's surface and of the effects of these characteristics upon man.

The word "climate" implies the physical characteristics of a given locality.

PHYSICS.

The elements which in their various modifying relations and proportions to one another constitute a climate are five—viz. Earth, Air, Water, Sunlight, and Electricity.

For the sake of better studying the fundamental causes of the varied peculiarities and effects of climate, certain subdivisions of the five elements are presented; but it must be borne in mind that in nature they are so closely interlaced one with the other that many of the divisions made, though convenient, are more or less arbitrary.

The first climatic element of the five enumerated is earth. This admits of two chief subdivisions—viz. composition and configuration, its composition ranging under two subdivisions—viz. soil and vegetation, and these being again divided as shown below:

EARTH.

- **Composition.—**
  - Soil
    - Rock,
    - Garden soil,
    - Clay,
    - Sand and gravel.
  - Vegetation
    - Trees,
    - Grass,
    - Plants.
- **Configuration.—**
  - Plains,
  - Mountains,
  - Valleys.

AIR.

Composition.—Nitrogen and oxygen, loosely combined, accompanied by watery vapor, ozone, electricity, carbonic acid, and more or less of germs, other gases, dust, etc.

Position.—Latitude—that is, distance from the equator (temperature decreasing and barometric pressure increasing from the equator to the poles).

Altitude.—Height above sea-level (barometric pressure decreasing whilst rising from the sea-level).

Distance from the Ocean.—Giving divisions into—

- Sea air
  - Ocean air,
  - Shore air,
  - Island air.
- Inland air
  - Plain air,
  - Mountain air,
  - Valley air.

- **Mobility.—**
  - Wind,
  - Calm.

Water.

Composition.—Hydrogen and oxygen chemically combined, accompanied by more or less salts and frequently vegetable and animal impurities.

Localized Water.—As in seas, lakes, streams, and springs.

Mobilized Water.—As in rain, snow, hail, and dew.

Vaporized Water.—As in clouds, mists, fogs, and the watery vapor of the atmosphere.

Water in Saturation.—As present in solid bodies, soils, rocks, and vegetation.

Sunlight, including Heat.

Light.— { Daylight { Sunlight, / Shade. ; Night { Darkness, / Moon- and star-light.

Temperature.— { Heat, / Cold.

Electricity.

Constant.— { Negative on the earth's surface, / Positive in atmosphere.

Inconstant.— { Thunder-storms, / Electric disturbances.

The Earth.

Composition.—*Soil.*—The temperature and humidity of the stratum of air lying immediately over it is modified by the intrinsic qualities of the soil. These qualities vary greatly. Dry clay can absorb its own weight of water, dry garden soil about half, and dry sand about a third. Sand dries most quickly, garden soil less so, but more quickly than clay. Sand is most readily heated, but cools equally fast. The temperature of the soil is usually about the same as that of the air above it. One soil will absorb moisture more rapidly than another, and evaporate more quickly, so that the air of a locality is much affected by the nature of the soil.

The humidity of the soil has a marked effect upon the prevalence of certain diseases, notably phthisis and rheumatism, and this is why a situation over a sandy or gravelly soil is preferable for residence. The humidity of the soil, when accompanied by slow decomposition of vegetation, is the cause of so-called telluric fevers, of which ague or malarial fever is the type. When inquiries are made concerning a health-resort

the nature of the soil is not sufficiently inquired into, though it is most important, as the same rainfall or snowfall upon a clay or sandy soil has a very different effect in the two instances. On clay it is retained at the time, and then given back to the air above it; but on sand or gravel it sipes through or runs off.

Vegetation has a considerable modifying influence upon climate, for where the vegetation is luxuriant there is an increased humidity of the air and soil; and this without necessarily greater precipitation, as notably in parts of Southern California, where the rainfall is moderate, but the actual humidity considerable, the vegetation and the soil absorbing moisture from the air, and then giving it off. The nature of the vegetation has much to do with this; the trees especially so, for if they are numerous, as in forests, the damp air is held by the shade which prevents the sunlight dissipating it in vapor. The deciduous trees give off and require more moisture, and thus increase the humidity far more than the evergreens, which grow mostly on a light soil and thrive with less moisture. Evergreens are thought also to be beneficial from their exhalations of antiseptic resinous vapors. Arable land with growing crops is usually more humid than meadow-land, and it is believed that the increased growing of crops brings increased rainfall, though this is not established.

Configuration.—Plains are exposed to uninterrupted sweeps of the wind, as seen in the cyclones and blizzards which prevail on the prairies of the Western States. When wide plains are dry they are heated and cooled equally, and when no side wind blows the cooled layer of air remains upon the ground, and therefore the difference between day and night is very marked. When the plains are free from vegetation and at a considerable distance from the sea, and at an altitude, they have the qualities of dryness and sunshine and purity of air which makes such plains as lie to the east of the Rocky Mountains, and in Asia such as the "Steppes of Tartary," excellent climates for the consumptive, who, however, must have shelter, as well as vitality enough to stand the occasional severe storms which rage there.

Where plains approach the mountains, owing to the proximity of the latter there are certain modifying protections from storms.

"In all mountainous countries there is a fixed cloud-region where a portion of the moisture rising from below is condensed during the summer months. This layer of cloud, by diminishing sunshine and radiation, lessens extremes. The formation of clouds which arise from damp winds is different; the former blow along the slopes, but the latter rise and cover the peaks. The air is cooled by these winds by its coming into a colder region and by its expansion from the diminution of pressure, and being cooled it precipitates most of its moisture in the form of rain, snow, or mist, and the wind that reaches the summit

falls on the other side of the chain in a variously oblique direction, and not directly down the slope; it condenses on the way, becoming warmer in descending, in the same way as it had become cooler in rising; also it becomes relatively drier, because warm air can hold more moisture. For this reason the lee side of the mountains is drier and more extreme in climate. Mountains often give a shelter from wind by diverting it, and may also diminish sunshine and give rise to other local conditions."[1]

"The climate of valleys varies very much with the way in which they are sheltered from cold and damp winds and are open toward the sun; the sides during sunshine increase the heat by radiation, and also diminish it at night. Therefore the extremes between day and night are more marked, while those between summer and winter days are not. The question of how much the sides cut short the hours of sunshine is important. These extremes of temperature when humidity is present give rise to mists and fogs in the valleys, while the upper slope may be in sunshine.

"*Aspect*—that is, the position toward the sun and wind—makes a great difference to a place, whether it lies on the sunny or shady side of a range, the sunny side in the northern hemisphere being the slope looking to the south-east or south-west. Besides the influence of the mountains upon winds as described, there is also a considerable effect from winds blowing over glaciers and snow-fields, bringing cold and, when melting, dampness."

The Air.

The air is certainly the most important element of climate, being the chief supporter of life and carrying with it most of the other elements.

Purity.—Angus Smith writes, very truly, that we are much more particular about a change in the water we drink than in the air, although we take in a far greater quantity of air than we do water. Moreover, the modification and filtration of water by cooking, by food, and by the digestive secretions are much greater than the changes produced in the air by its passage through the respiratory tract, even in health; and these are at best imperfect guards.

Oxygen and Carbonic Acid.—The amount of oxygen relatively varies but slightly in a given weight of air, being only a matter of decimals. However, when we consider the large quantity of air taken

[1] "Klimatotherapie," von Dr. Hermann Weber, *Handbuch der Allegemeinen Therapie*, Leipzig, verlag von F. C. W. Vogel, 1880. This able and comprehensive work is the best treatise written upon climate, and I have availed myself largely of the information therein contained, and for the most part followed Weber's plan of classification of the various branches of the subject.

in during respiration, and that when the oxygen is deficient the amount is made up by some other gas, nominally carbonic acid, even a slightly lessened quantity of oxygen is often a serious matter. The oxygen is in excess, while the carbonic acid is less, where the locality is open, as on uncultivated plains and mountains, whilst, on the other hand, in towns during wet (and especially during foggy) weather there is a marked increase of carbonic acid. The absorption of carbonic acid in large amounts is undoubtedly deleterious, but, as Dr. Weber remarks, in remaining for some time in a salt vapor-bath, which contains more than 3 per cent. of the gas, no discomfort is felt, whereas in crowded rooms, which contain only 1 per cent., nausea and headache are soon experienced; it is probable that other conditions, which the decomposition of animal matter gives rise to, besides the formation of carbonic acid, are chiefly answerable for the symptoms of poisoning.

Ozone.—So far, little is known about this. Most chemists regard it as allotropic oxygen, containing three atoms of oxygen. The following points, however, may be considered as fairly established: That it is a powerful disinfectant, more so than ordinary oxygen, though as 1 part of ozone in 700,000 of atmospheric air is about as much as is ever found, its direct action through the atmosphere must be insignificant. Ozone, however, is absent where injurious decomposition is going on, as in sick-chambers, and is least in towns and greatest on the sea and mountains and under pine woods. The value of its presence would appear rather to be as evidence of the atmospheric purity than as a disinfectant. It is increased by thunder-storms and intense sunlight.

Dust, Germs, and other Foreign Bodies.—One of the chief reasons for the climatic benefits of sea- and mountain-air is the absence of poisonous or irritating substances floating on it.

Position.—The atmosphere of a locality is largely influenced by its distance from the equator—in short, by its latitude.

Latitude.—The weight of the atmosphere at sea-level is equal to a column of mercury 760 to 761 mm. in height. The column of mercury is specially low near the equator, being about 75 mm., because of the expansion of the air by heat, the lighter air rising and flowing away in the upper regions toward the poles. Leaving the equator, the pressure rises until it is highest between latitudes 30° and 40°, being there about 763 mm. to 764 mm. This appears to be caused by the currents flowing to and from the equator and the poles lying over one another. Farther toward the poles the pressure diminishes again, and is lowest between 60° and 70° north latitude.

Altitude.—The pressure continuously diminishes with the height, because the column of air above an elevated place weighs less than that at the level of the sea. The lower layers of air are much heavier than the higher, so that the air at sea-level is 1.6 times as dense as that at

Potosi, which is 13,000 feet above it. In the same locality the variations are partly periodical and partly unperiodical or accidental.

Distance from the Ocean.—Starting from the ocean itself and gradually going inland till we reach the centre of a continent, we find modifications of climate occurring which are dependent chiefly upon two main causes—the lessened humidity, owing to the distance from the evaporation from the ocean, and lessened density of the air, owing to the rise in the height of the land.

There are of course modifying local causes, as where great lakes or inland seas intervene, or the land, instead of following the general tendency toward elevation, is depressed. The especial qualities of the different airs will be discussed later.

Mobility.—*Currents and Winds*—their causes have already been explained. On the sea-coasts the usual daily sea and land breezes are accounted for in this manner: During the day the layers of air immediately covering the land become hotter than those over the sea. They rise into the upper air and flow away, and the heavier and colder layer over the sea comes in to take their place, thus producing the sea breeze, which is usually at its height in the early afternoon. After sunset, the radiation from the earth being greater than that from the sea, the layer of air over the land becomes heavier, and the sea layer, being lighter, flows away, and the breeze blows off the land to fill the void it tends to make.

Mountain and Valley Winds.—During the day the soil and lower walls of the valleys are strongly heated; consequently, the lowest layers of air in the valleys begin to rise along the mountain-slopes, radiating more rapidly than the bottom and sides of the valleys; the cold air descends with more or less force as the evening wind. For this reason places on the mountain-sides are often warmer in the evening and night than those lower in the valley. This consideration is often of consequence as regards the value of a particular valley as a health-resort, and further with respect to special houses or hotels in it. When there is a heavy rain- or snowfall or melting snows, these breezes, being damp, are apt to detract seriously from the otherwise good qualities of the resort. Dr. Weber writes as follows: "The winds are an important element in climatology, since they often quickly change the temperature, humidity, and pressure of the atmosphere, and in a way carry the climate of one place to another more or less distant; they have a great influence upon the purity of the air. It is not only the name, east, west, or north, which is to be looked to, but the character which winds from particular directions have at particular times of the year. One must therefore know how frequently winds of a certain nature blow in a given health-resort, how it is exposed or sheltered from them, or in what way they are modified by the configuration of

the neighborhood. They withdraw more or less heat from the body and evaporate more or less moisture from the surface, according to their temperature and humidity and their speed, which varies between 1 and 120 feet per second. Strong and cold winds are dangerous to patients with lung disease and to the rheumatic and gouty, while moderate currents are beneficial, especially in warm weather. They act in a more or less powerful manner, give the climate a stimulating character, taking the strength of the accommodation of the organism into account, and keep it exercised; but they demand a certain degree of strength of resistance."

Water.

Composition.—No water present in nature is absolutely pure, all containing more or less of salts, from the dense water of Salt Lake to rain-water, which is the nearest approach to distilled water that nature provides us with. Animal life is also more or less present, and vegetable and animal impurities are common.

Localized Water.—Seas, lakes, and rivers, all have modifying influences on the climate, always increasing the humidity of the air, and generally the rainfall, and in the case of seas, large lakes, and wide rivers providing over their surfaces large spaces of fresh, uncontaminated air, and giving rise to daily breezes from and toward the water, owing to the difference in the radiation of heat between the land and water. These peculiarities are experienced more upon the surface of the ocean, lake, or river than upon the shore.

Mobilized Water.—The watery vapor always present in a greater or less amount in the atmosphere is spoken of as the humidity of the air; this is of two kinds, absolute and relative.

Humidity.

Absolute Humidity is the absolute number of grains of vapor in a given quantity of air.

Relative Humidity is the amount contained by the air relative to what it could contain, the standard maximum being 100 per cent. The lowest relative humidity, according to Humboldt, is 25 per cent.; under 55 per cent. is called very dry; under 75 moderate, to under 85 moderately damp; over which, very damp. Relative humidity is only valuable when the temperature is taken with it, as warm air takes up more vapor than cold.

Clouds have an important influence upon invalids, depriving them of the advantage of the sun.

Rainfall is not synonymous with humidity, as very often the rainfall is very slight, yet the air is quite humid, as in Southern California, for example; for if there are no cold currents the vapor in the air will

not be precipitated in the form of rain. The Swiss hygrometric observations show that precipitation increases with elevation, with exceptions, as in the valley of the Engadine, where the mountains give shelter from the north and west. But in North America, as a rule, the reverse is true. The general rule is that the rainfall diminishes with increased distance from the sea-coast. The amount of rainfall and number of rainy days by no means necessarily agree, as in some places, where the rain is never moderate, there may fall in a few days more rain than is made up by a number of rainy days elsewhere. This point is of special importance as determining the number of days of outdoor life for the invalid. Speaking broadly, the number of rainy days increases from the tropics to the poles, while the amount of rainfall diminishes. With elevation up to a certain height the number of rainy days increase, above which they decrease. Rain is not necessarily prejudicial to invalids; if not so frequent or excessive as to prevent a proper amount of exercise in open air, it has the advantage of purifying the atmosphere, besides making it perhaps more vivifying by the formation of ozone and lessening of relative humidity, as people usually feel fresher and more active both during and after rain.

Snow.—The line of perpetual snow is lower going toward the poles, lower on the northern slopes of the mountains, and lower where the air is damp. Snow is not necessarily prejudicial to weak invalids, but frequent melting is of course bad. Covering of the ground with snow is often attended with advantage, as it prevents the formation of spores; snow on a clay soil, however, is always bad for invalids.

Evaporation.—The evaporative power of the air of a place is important; it is variable, depending upon the temperature, relative humidity, density, and rate of motion of the air. It is greater when the air is warm and dry, and is increased by wind; it is small when the air is still and near the point of saturation. It is most powerful in the summer, in the sun and wind, and only slight in winter, in shade, and when the air is calm. It is most active at midday, and is almost absent during continued rain or clouds or calm. It is by this evaporative power or thirstiness that the air is kept continually supplied with moisture, which is essential to organic life on the earth's surface. This humidity in the atmosphere, in checking the radiation from the earth by absorbing the heat, and also by partly arresting the direct rays of the sun, and thus regulating the light and heat, is a most powerful moderator of climate. It is the medium for the formation of dew, rain, and snow, and is closely connected with ozone and electricity. The difference between sun and shade and day and night is very great in dry climates and seasons; on the other hand, the rays of the sun may be obscured for days and weeks by too much moisture,

and the climate become depressing, both physically and mentally. This question of moisture, is, on the whole, the most important factor in considering the therapeutic action of a given climate.

Sun.

Light.—The direct action of light, apart from heat, is difficult of investigation: however, the experiments of Downes and Blunt show that light hinders the development of bacteria and other low organisms, though Tyndall's communication to the Royal Society in 1878 gave evidence of this not being constant under light alone. Moleschott's experiments on frogs show that light increases oxidation. Sunlight is more intense, of course, in dry air, and more prolonged in high latitudes in the summer, and *vice versâ* in the winter; and this point has to be considered in regard to mountain-valleys. Dr. Weber's clinical observations show that a want of sunlight produces the following symptoms: Depression of spirits, lack of energy and loss of appetite, disturbance of digestion, turbid urine, and a kind of homesickness; he also has found an irregular type of intermittent fever occurring in servants and others who sleep or pass much time in rooms half under ground, where no ordinary malarial causes are present. In one case enlargement of the spleen took place. These cases are best treated by large doses of quinine, and relapses prevented by enlarging the windows. My own experience in London leads me to believe that Dr. Weber's explanation of these symptoms is correct.

Temperature.—General Causes of Heat.—The cause of the warmth of the atmosphere and the earth's surface is mainly the sun, which raises the temperature—

(*a*) By its direct heat or radiation;

(*b*) By indirect radiation, chiefly through the reflection from the earth;

(*c*) By conduction from the earth;

(*d*) By currents.

(*a*) Direct radiation conveys but little warmth, since the air is diathermanous to the sun's rays, letting them through it, and it is only by means of aqueous vapor that they part with any heat on the way, so that the damper the air the more it is heated by the sun.

(*b*) Indirect radiation or reflection, which is chiefly reflection from the earth's surface, is influenced by the nature of the solid and liquid surfaces; most of this heat is reflected back at once; the rest is retained for a longer or shorter time on the ground; then all, or at least a greater part, is radiated back into the atmosphere.

(*c*) The earth gives up a portion of the warmth which it has taken

up to the layer of air in immediate contact, which rises and is replaced by a heavier and cooler layer, which in its turn rises and gives place to another, and so on, and thus a large amount of air is warmed.

(*d*) Currents are the most important events in the aërial ocean, by which changes called into existence at one place are carried to distant spots. The heating of a layer of air by conduction and radiation causes it to rise, and the cold air comes in to take its place, giving rise to a current which when marked is called a wind ; by these currents heated air is carried from the equator to the poles.

Cold.—To counteract the heating process first named there are constant cooling influences at work :

(*a*) Continual radiation of heat into space, where the temperature is very low ;

(*b*) A fluctuating amount of heat rendered latent by evaporation from the ground, waters, and plants :

(*c*) When the earth, which radiates heat more quickly than the air, becomes cooler than the atmosphere, the latter gives up heat by radiation as well as by direct conduction.

The chief local causes that lessen the temperature of a climate are elevation above sea-level, neighborhood of an east coast, high ranges, shutting off warm winds, wide seas between it and the equator, or absence of open water toward the poles, cloudy summers and a clear sky in winter, and cold currents, such as the one which comes down the east coast of North America from the Arctic regions.

Heat.—Local Causes of Heat.—If the earth's surface was uniform in shape and quality, and the amount of aqueous vapor in the atmosphere everywhere the same, one could accurately calculate the temperature of a climate by its latitude—that is, its distance from the equator ; but the qualifying influences of mountains, valleys, vegetation, soil, and waters make this impossible, so that in a general way only can it be said that heat decreases with distance from the tropics. The difference between summer and winter also increases at the same time, because the sun's rays grow less perpendicular and the hours of sunlight shorter as the distance from the equator grows greater. The causes of increase of climatic temperature are numerous, as by the Gulf Stream or other warm-water currents, or warm-air currents, as caused by winds from over warm seas or deserts, shelter from cold winds by chains of mountains, the neighborhood of a west coast, and similar causes.

The Mean Annual Temperature "is of less importance to the physician than that of the various seasons, as the most different climates may have the same annual mean." It is further of "great importance to know the single temperatures during certain hours of single days, as it is only in this way that the physician can determine

the average number of hours available for outdoor exercise by invalids" (*Weber*).

Electricity.

The atmosphere is charged with positive, the earth with negative, electricity. Becquerel and Breschet have demonstrated that at altitudes under a clear sky the positive electricity in the air is increased. The temperature being lower also, makes this to be suspected, and it doubtless has much to do with the feeling of exhilaration which is usually experienced at medium elevations. Thunder-storms are more frequent between 3500 and 6500 feet above sea-level than at greater or lesser altitudes.

PHYSIOLOGY.

The general effects of heat and cold upon the human organism are as follows: Heat causes less food to be needed, increases the growth, but lessens the muscular force, as shown by Rattray. Dampness increases the depressing effects of heat.

Cold causes more carbonic acid to be given off and more waste of substance, does not increase growth, but inclines toward its preservation, while increasing muscular power. As evidence of how mistaken is the usual dread of cold, mortality diminishes from the equator to the poles.

The effects of damp air are so modified by temperature, pressure, and wind that one can hardly speak definitely of its action in these directions. However, there are many important points which are fairly established. The degree of absolute humidity—that is, the actual amount of vapor in so many cubic inches of air—is of consequence in breathing, since the air breathed from the lungs is not only warmed, but also saturated with moisture exhaled from the tissues and the amount of moisture already contained in the outside air, and the drier the atmosphere the greater the loss of water by the lungs. As has been shown, cold air contains less vapor than warm; therefore there is also more loss of water by the lungs when the atmospheric air is cold; so in this way the relative humidity is of consequence. Weber states that "a diminution of the secretion of the mucous membrane of the respiratory organs is a frequent result of living in dry air—a circumstance of considerable importance in the treatment of chronic catarrhal and ulcerative conditions;" and he further remarks upon the value of loss of heat by the lungs when the air inspired is cold and when its dryness demands increased evaporation, which latter, it is well known, is a most powerful agent in the reduction of heat. These facts apply to the skin by the laws of osmosis; that is, the perspiration is increased, and if the air is very dry the perspiration is not perceptible upon the skin, because the air, if it is warm, so greedily takes up the water;

and this is why in a dry climate hot weather is so much more endurable than in a damp one. The reason, again, that in a dry climate cold weather also is more endurable is explained as follows by Dr. Weber: "Heat is also lost by evaporation in cold weather when the air is dry, but the loss is not great, and can be very much limited by clothing when there is not a strong wind at the same time. On the other hand, when the air is damp the loss of heat from conduction is much greater than in dry air, and is much increased by wind; so that damp air when dew is falling feels often colder than during frost when it is dry, even though it may be ten degrees or fifteen degrees less cold." Let us further consider the functions of the skin for exhaling heat and moisture or for inhaling them, for the skin, being a damp, porous membrane necessary to produce the phenomena of osmosis, acts in both ways, and there is the effort at equalization and exchange that the law of osmosis implies. Thus, when there is greater heat or cold or greater moisture or dryness outside the skin, the usual process is reversed: first, when the temperature of the air is over blood-heat we have the body heated, and all the results which ensue from high temperature, sunstroke, etc. Then with cold, if cold is absorbed by the skin faster than the heat-producing powers of the body can compensate for, we have, first, superficial paralysis and death—that is, frost-bite; then paralysis of internal and vital organs, from which stoppage results in death of the whole system.

When the temperature of the atmosphere is at the freezing-point or lower the absorption of the cold through the skin is qualified probably in this manner: As heat relaxes the cutaneous nerves, so cold stimulates them, and the first effect of cold is to contract the fine muscles of the skin and close its pores, producing the appearance that is called goose-flesh and checking evaporation. Second, the nerves which supply the blood-vessels contract them, so that the supply of blood to the skin is shut off, thus making it temporarily as little sensitive or able to be affected by outside influences as the nails or hair; further, the blood which is thus withdrawn from the skin goes to increase the volume of the general circulation, making it brisker and more vigorous about the heart and other vital organs, and thus conveying the exhilarating sensations of cold. These are the effects produced when the cold is dry. When it is damp, as has been shown, the changes of temperature are so much less markedly felt that the nerves do not respond as readily, the blood-vessels are only slowly closed, and the blood dribbles, as it were, through the vessels of the skin, losing its heat, and thus throwing cooled blood back on the lungs and heart, causing a general chill. The fact that the damp air robs the nerves of their electric tension would be another reason why the nerves respond more tardily and imperfectly. These statements explain why in dry cold our skins

feel colder and our bodies warmer, while in damp cold we do not feel especially cold, but as if the cold was creating a draft through our very marrow. Wind of course heightens these effects in both damp and dry air. "Heat and cold, as has been stated, are better borne in dry than in damp air, but dry air combined with very low temperatures acts as an irritant to the mucous membranes of the organs of respiration, and excites a disposition to inflammatory diseases, especially pneumonia, while damp air combined with cold disposes to catarrh and bronchitis, also rheumatic and gouty affections. Damp air combined with warmth, on the other hand, exercises a soothing influence on the mucous membrane. Demands on the strength are diminished, however, by its long-continued action; the appetite and functions of the organs of digestion and the nervous system are not infrequently depressed; a kind of relaxation and diminished power of resistance to certain noxious attacks from outside appears, such as a tendency to diarrhœa, as we have often observed not only in invalids to whom we have recommended such climates, but also and still more frequently in healthy people who have been with them as companions. The separation of water by the lungs and skin is diminished in great dampness, and more work devolves upon the kidneys, while their activity is less called upon when the air is dry and warm; and we must always pay great attention to this in affections of the kidneys." Clinical observation leads me to believe that not only are the kidneys in disease relieved when the air is dry and warm, but also when it is dry and cold. There is more water exhaled by the lungs in cold air than in warm, for the reason of its greater dryness; and this may more than compensate for the lessened loss by the skin; further, the improvement in the general circulation caused by the cold must relieve the venous congestion of the kidneys and make the elimination more perfect and regular. Perhaps above all, for reasons already given, the fact that the risk of catching cold in cold dry air is much lessened may mainly serve to explain the good health I have observed in cases of Bright's disease, even in windy weather when the air was dry and cold.

"A sudden increase in the humidity of the air appears to cause a considerable modification of the functions of the body, in a manner similar to those caused by a sudden increase of heat. The separation of moisture by the lungs and skin is diminished, so it must be increased through the kidneys and intestinal canal; increased flow of urine and diarrhœa not infrequently follow" (Stewart, Hirsch, Thomas, Rohden); and if the superfluity of water is not gotten rid of in this way, the beginning of an increasing quantity of liquid in the blood-vessels is felt; and to this circumstance Rohden ascribes the increase of

hæmorrhages from the lungs on a sudden increase of humidity of the air.

THE PHYSIOLOGICAL EFFECTS OF INCREASED AND DECREASED PRESSURE are so bound up with the other conditions, such as heat and moisture, that they are not easily determined.

The experiments of Vivenot, Lange, Paum, and G. von Liebig show that by an addition of one-half to two atmospheres the lung-capacity is increased, the number of inspirations and beats of the pulse are decreased, while the pulse becomes stronger; more oxygen is absorbed by the blood and more carbonic acid given off; and the appetite is improved.

Most observations concerning increased pressure have been made in balloon and mountain ascents, and are difficult to separate from the effects of temperature and ozone; and, in addition to this, in mountain ascents the exertion used has a qualifying influence. Dr. Weber made some twenty-eight interesting observations upon persons carried up a mountain in sedan-chairs, whereby the ascent was devoid of exertion. Space will not permit me to give the details, but of them he writes: "Collecting the manifestations, we find only moderate increase of frequency in pulse and breathing in those who were not invalids at elevations of 1100 and 1500 metres, with a sensation of comfort and ease of movement, increased hunger and thirst, and diminished disposition to perspire. But a greater elevation, 3000 to 3300 metres, heightened the frequency of the pulse and breathing in many individual cases; slight muscular exertion rendered the action of the heart irregular and extremely weak, while manifestations of weakness and symptoms of mountain-sickness arose, which appeared to be caused by anæmia of the brain, and were made better by stimulants and rest in a horizontal position. In not a few cases of tolerably strong individuals the activity of the brain appeared to be remarkable at a height of over 1500 metres, in rare cases to a disquieting degree, on which depends the frequent occurrence of sleeplessness to a greater or less extent; and it is also to be remarked that a smaller number of hours of sleep generally appears to be necessary at elevations than on plains or by the sea." I myself have confirmed these observations in going to great elevations in the Rocky Mounntains, such as the summit of Pike's Peak.

That there is usually at elevations a great tolerance of alcoholic drinks is Dr. Weber's opinion, formed from his experience in the Alps, and he suggests that this may be accounted for by the rapid evaporation which occurs in rarefied air. My own observations in Colorado at a height of 6000 feet and more lead me to the conclusion that most persons are more readily affected by alcohol, and require less to procure its effects, but that the effects are more transitory; and this agrees with

what science teaches us: evaporation being more rapid in elevated places, it necessarily follows that absorption is equally speedy. As a rule, persons in high altitudes state that they use and require less alcohol than in the lower levels. I have further been led by personal observation and inquiry to believe that there is much more tolerance of alcohol, and more benefit and desire for it, in a damp than in a dry climate. I have observed this by contrasts between England and Scotland, Egypt and Colorado, in my own case and in those of others passing from one country to another. The limits of this article will not permit further discussion of this topic, but it seems probable that the amount of humidity largely modifies the direct influence of altitude in special localities with regard to the effect of alcohol on the general system.

The experiences of Gay-Lussac and Glaisher, Croce, Spinelli, Sivel, and others in high altitudes all show that it is possible to remain at a height of 7600 metres without hæmorrhage—that at 7000 metres rapid pulse, shortness of breath, and blueness of skin are experienced; at 8000 metres, difficulty in moving the limbs, and loss of consciousness on going higher, and probable death from effusion of blood.

The observations of Leyden, Lehwess, and others upon laborers who when working in mines and caissons under a pressure of two or three atmospheres suddenly return to a normal atmosphere, show as results smarting in the ears and joints, giddiness and nausea, and in some cases paralysis, from which most sufferers recovered, but in one fatal case curious furrows or rents were found in the spinal marrow.

With great moisture in the air we have distension of all the blood-vessels, especially the veins, and consequently great sluggishness of circulation. As the respiration is impeded by a slow circulation and becomes imperfect, the blood not getting thoroughly oxygenated, increased venosity—that is, more than the proper proportion of venous blood in the circulation—ensues, and the weight of the body is increased by more water in the tissues.

When, on the other hand, the air is dry, the body loses its moisture rapidly and the circulation is hastened; consequently the blood receives oxygen more frequently, and a state of increased arteriosity, to coin a word—that is, an increased amount of arterial or oxygenated blood—is produced. This quickened circulation, by stimulating the various organs, produces increased metamorphosis, especially destruction of the fats by oxidation, and the tissues are drained of their moisture. The nervous system participates in this general stimulation, especially from the more frequent supply of highly oxygenated blood to it, and the extreme results are loss of weight and fat, a too rapid waste and over-stimulation of the nervous system, and consequent rapid wearing out and incapacity for sustained exertion. The phlegmatic and corpulent

Dutchman is Nature's type of increased venosity, and the spare, nervous Yankee the best specimen of increased arteriosity climatically produced.

This arbitrary separation of the effects upon the body of the elements of heat and cold, dampness and dryness, in the atmosphere is of course not absolutely true to nature, for one modifies the other; and, above all, there are modifications with which the human organism is specially provided to combat these extremes. As man's digestion is prepared to extract nourishment from all forms of food, so is his system prepared to extract from all forms of climate what he needs of heat, moisture, and oxygen, which three elements constitute his cutaneous and pulmonary food. Let us therefore briefly consider these modifications. When the air is hotter than the body, the absorption of heat by the skin is modified by the increased perspiration, which gives rise to the cooling effects of evaporation, but to produce efficient evaporation the air must be sufficiently dry to take up rapidly the water of the perspiration; if it cannot, the body suffers the results of overheating.

It is commonly supposed that sunstroke is caused solely by the hot sun, but this is not so. Of course there must first be an atmosphere of a temperature sufficiently above blood-heat to give rise to mischief; but this granted, it is the extent to which the power of evaporation from the skin is checked that regulates the amount of damage done. This is very clearly shown by the fact that in a damp climate, where evaporation is limited, even with a much lower temperature, sunstroke is much more common than in a dry one. I have personally verified this by comparisons made on the spot in England, Egypt, and Colorado. To produce the most complete amount of evaporation from the skin, granting a dry atmosphere, there must be complete relaxation of the cutaneous nerves. This is perhaps why the drinking of alcoholic beverages so markedly increases the dangers of sunstroke by producing an irregular action of these nerves through its stupefying effects upon the nerve-centres, and in some measure by its well-known property of checking the elimination of waste products. Some observations were made in England a few years ago, comparing the amount and severity of cases of sunstroke among the harvest-laborers in the districts where they drank cider in the fields and in other districts where they drank beer, and it was found that where the stronger liquor, beer, was taken there was more sunstroke.

Geographical Distribution of Disease and Racial Distinctions.

We will now discuss the general effects of climate in causing the peculiarities of the various races of man and the geographical distribu-

tion of disease, the latter being the classification of the diseases to which man is most prone in special localities.

Man, more than any other animal, can assimilate himself to various climates, bearing the change generally without harm, and frequently with benefit. This capacity is, however, as might be supposed, much more developed in the natives of temperate climates than in those of polar or tropical regions.

The physical and intellectual differences of the various branches of the human family are justly ascribed, I believe, to climatic influences, although there are still a few who argue against this theory and believe the differences were originally impressed upon the species; in short, it is the old argument between evolution and design, in which the former has very much the best of it.

There are two facts which are prominent in the study of the effects of climate upon man in causing racial peculiarities. The first is, that commonly, if natives of one climate are domesticated in another and different climate, in the course of a few generations the descendants of these foreigners take on the racial peculiarities of the people among whom they are reared to such an extent as to submerge or modify the characteristics of their ancestors, so that it is generally difficult to distinguish them from the ordinary natives. The second is that a succession of ages has failed to impart to natives of other countries the peculiarities of the Ethiopian and Mongolian races among whom they have made their home; and this fact is an argument in favor of original conformation, though it may be only climatic effect extending over immense periods of time.

The absence of sunlight and the continuous extreme cold for two-thirds of the year produce the stunted frames and weak muscles of the Esquimaux, Laplanders, and others who reside in or near the Arctic regions; their features retain the appearance of youth till old age comes on. The intellectual and moral qualities are ill developed and torpid; the circulation is feeble and the nervous system dull; diseases assume an asthenic form, fevers being of a low type and inflammations rarely sthenic. Owing to the natives crowding together for warmth in their ill-ventilated houses, contagious diseases, when contracted, spread rapidly among them and act with virulence, but except in such cases, and except for the benumbing and debilitating effects of extreme cold and scarcity of food, they are liable to few diseases. When, however, the inhabitants of polar countries migrate to more temperate climates, they readily receive and easily succumb to febrile and inflammatory diseases, and require an especially tonic treatment.

Countries situated between forty-five and sixty-three degrees of north-western latitude are inhabited by the most robust and enduring of our species in respect to both physical and intellectual powers.

In discussing the influence of climate in causing peculiarities of race and disease, Dr. Copland[1] writes as follows: "It may be stated in general of the northern temperate zone that the inhabitants of its more southerly countries have made the earliest advances in civilization, and that those of its middle and more northerly climates have carried the useful arts and sciences to the highest perfection. Within the range of this zone man presents the greatest diversity of temperament, of constitution, and of mental endowment. Muscular frames, plethoric habits of body, and the sanguine temperament predominate among the natives of the more northerly of temperate climates, particularly as regards Europe and its western countries. Affections of the chest and respiratory organs, inflammations, fevers complicated with inflammations of the lungs or of the brain, and rheumatism, are the most prevalent diseases.

"Epidemics assume most frequently amongst them a phlogistic character, and vascular depletions are more required and better borne in the treatment of their maladies. Climates which are the most variable as to both the commencement and the course of the different seasons are, notwithstanding the many disadvantages imputed to them, the most favorable to the advancement of the various bodily and mental powers. The rapid and frequent vicissitudes of weather preclude, as respects the community generally, the regular adoption of means to guard the body against their operation; consequently, the frame becomes habituated to their operation, and thereby fortified against the injurious impressions which would be otherwise made by them. That countries thus circumstanced are benefited rather than injured by this state of weather and season is shown by the robust frames, the mental activity, and the longevity of their inhabitants. The physical and moral history of the British Isles, Denmark, Sweden, and the more continental districts of Western Europe demonstrate this fact. In the eastern countries of this quarter of the globe, as well as in Central Asia and in North America, the seasons being much more regular in their advent and in their course, measures are more regularly and uniformly adopted to moderate the extremes of temperature and the vicissitudes of weather; and these have in many instances the effect of enervating the frame, of promoting the extension or prevalence of disease, and of thereby diminishing the mean duration of human life. Of this description is the use of excessively warm clothing, and of stoves which overheat the air of the apartments without renewing it as rapidly as is often requisite to the wants of the economy. Hence, whilst the external atmosphere is cold, dry, and invigorating to the healthy frame in a state of activity, the air indoors is close, warm, and

[1] *A Dictionary of Practical Medicine*, by James Copland, M. D., F. R. S., London, vol. i. p. 343.

depressing, the frequent alternation from the one to the other, or the constant residence in the latter, being injurious even to those in health and causing diseases of the thoracic and abdominal viscera.[1]

"While the natives of northerly inland countries suffer more especially from the extremes of temperature and of season, and the circumstances which arise out of them, they are less exposed to those emanations which arise chiefly from the decomposition of vegetable and animal matter, and to those endemic sources of disease that produce so much suffering and mortality in low or level districts and in more southerly climates, where the atmosphere is moist and warm. The inhabitants of temperate countries considerably elevated above the level of the sea, and of mountainous places, are generally of a spare, firm, and muscular habit of body, and strongly formed, chiefly owing to their active and industrious modes of life and the pure and light state of the air they breathe. The irritable, sanguine, and nervous temperaments, and quick, irritable, and generous dispositions, predominate among them. Inflammatory, hæmorrhagic, and spasmodic diseases, particularly hæmoptysis, bronchitis, consumption, asthma, inflammations of the lungs and pleura, rheumatism, and disorders of the circulatory organs, are most common. Their females are more virtuous and prolific, and the mean duration of human life longer, than amongst the natives of lower districts and warmer climates.

"There are certain peculiarities in the natives of countries, particularly of European countries, that must strike the pathologist as intimately connected with the nature and treatment of their diseases. These are chiefly the complexion of the skin, the large development of the respiratory and biliary, nervous, and circulating organs, compared with those of the natives of intertropical countries. The skin of the dark races is not only different in color, but it is also considerably modified in texture, so as to enable it to perform a greater extent of function than the more delicately-formed skin of the white variety of the species. The thick, dark rete mucosum of the former is evidently more suited to the warm, moist, and miasmal climates of the tropics than that with which the latter variety is provided. The skin of the negro is a much more active organ of depuration than that of the white. It not merely exhales a larger proportion of aqueous fluid and carbonic acid from the blood, but it also elaborates a more unctuous secretion, which by its abundance and sensible properties evidently possesses a very considerable influence in counteracting the heating effects of the sun's rays upon the body and in carrying off the superabundant caloric. Whilst the active functions, aided by the color of the skin, thus tend to diminish the heat of the body and to prevent its excessive

[1] This applies with great force to the habitations of the average American citizen. —S. E. Solly.

increase by the temperature of the climate, those materials that require removal from the blood are eliminated by this surface, which, in the negro especially, performs excreting functions very evidently in aid of those of respiration and of biliary secretions. In the white variety of the species, on the other hand, the functions of the lungs and liver are much more active than in the darker races, changes to a greater extent being performed by respiration in the former than in the latter, as I have proved by experiment. The liver is also larger, and its secretions more copious, in the European than in the negro or Mongolian.

"In the inhabitants of northern climates and elevated or cold countries the functions of the lungs and kidneys are extremely prominent, and those of the skin and liver much less so, eliminating or depurating actions on the blood being performed chiefly by the former organs. But in the natives of intertropical climates the skin assumes, as shown above, a more extensive function, and by its activity compensates for the diminished operation of the lungs, liver, and kidneys generally observed among them, aided, no doubt, by the secretions from the intestinal mucous surface. In temperate countries the various emunctories of the frame present a degree of activity in strict keeping with this general connection of climate with the development and activity of these functions. In the warmer districts of temperate climates, and especially those which are subjected to a dense, moist, and miasmal atmosphere, the changes produced by respiration are diminished, and those effected by the cutaneous and intestinal mucous surfaces are increased. If the natives of such districts belong to the white variety of the species, their cutaneous surface not being constituted so as to enable it to perform the compensating action for which the skin of the darker races is destined, a different organ performs this office, and the liver assumes an increased action, combining and eliminating several of the effete constituents or elements as they accumulate in the circulation, thereby giving rise to an increased and modified biliary secretion.

"As the physical and intellectual powers of man enable him to occupy the whole surface of the globe, it follows that he cannot be restricted to any particular kind of food; in other words, he must be naturally omnivorous as a consequence of his ubiquity.

"It appears to be a salutary law of nature that in those climates where animal food would be detrimental to the human race, there the animals usually destined for the purpose are few in number and stunted in growth. The localities, indeed, which are the most destructive to man are also the most inimical to these animals, which, if they were chosen as the chief article of food, would both dispose to disease and increase its fatality. Thus, it appears that the distribution of the classes of animals over the surface of the globe is so apportioned, and certain of their orders and genera so restricted to particular latitudes and climes,

as to be subservient to the wants of man, without becoming hurtful or endangering existence in countries in many respects unfavorable to his bodily and mental development.

"While the vegetable diet which the hottest and most unhealthy climates furnish is the least liable to excite the nervous system, or to overload the circulating and secreting organs, or to irritate and inflame the excreting viscera, it serves to promote endurance, and, with the hot spices which grow spontaneously in the same localities, to counteract the contaminating changes produced in the body by the vegeto-animal effluviæ to which it is frequently exposed.

"From these and other considerations the following corollaries may be drawn: That the climate of a country should, in a great measure, guide man in his selection of food, those productions which are most abundant around him being most appropriate to the circumstances in which he is placed; and that the nature of his food thus conspires with the climate to modify his constitution, whilst it serves to counteract the rigors of season and the unwholesome influences to which he is constantly exposed in very hot as well as in very cold countries."

Classification of Climates.

This is at the best extremely unsatisfactory, the important elements being so interlaced as to make a complete disentanglement of them for the purpose of grouping climates under separate heads almost impossible. For some purposes the classification which may be termed a geographical one is the best; that is, into two grand divisions—viz. sea and inland, and these again into sea, island, and coast under the first head, and plain and mountain under the second; whilst for others the division into cool and moderately damp, cool and very damp, cool and moderately dry, cool and very dry, warm and moderately dry, and warm and very dry, has much to recommend it; however, in all these divisions there are the objections that pertain to generalization.

Sea Climates.—The climate of the ocean of course varies considerably in different latitudes and under the remote effects of the land upon ocean-currents, as in the case of the Gulf Stream, where the waters heated in the Gulf are poured into the ocean and carry its heat for many thousands of miles, or, on the other hand, where the waters from the polar regions bring the melting icebergs toward southern latitudes. Apart from these special influences, however, the most marked characteristic of our ocean climate is its equability, not only of daily temperature, but also lessened contrast between day and night, summer and winter. The reason for this is mainly on account of the water absorbing the sun's heat by day, and then returning it to the atmosphere by night. On shore the earth's surface absorbs but little of the sun's heat, and instead radiates it back

into the air at once, thus greatly increasing the aërial temperature, while at night, there being little heat to be returned from the earth, the natural cooling of the air goes on without being mitigated, as it is over the ocean, by the heat from the water being returned to the air.

Another marked and constant characteristic is the great humidity of the air, due to the vapor given off from the water. This, of course, acting as a veil, lessens the force of both the sun's light and heat by day, by absorbing much of it as it passes through. At night this stored-up heat is given off, thus lessening the sharp contrast between day and night; and a similar change prevails between winter and summer. The sea-air is impregnated with saline particles, and in small amounts by the gases of iodine and bromine, and is free from dust and germs. The amount of ozone is always very large. The electricity is more negative than on shore, a return to equilibrium being more easily established. There is of course great mobility of atmosphere, and, owing to the absence of any wind-breaks, heavy winds often carry the climate of distant coasts over the ocean, and thus its natural equability is greatly modified.

Physiological Effects.—The study of the physiological effects of these conditions has been very imperfect, but we are indebted to the valuable researches of Beneke for certain facts. A warm liquid cools more rapidly under like conditions on the sea-shore than inland, and particularly so in contrast to elevated regions; therefore the loss of bodily heat is greater at the sea. Experience tells one that warmer clothing is needed, in proportion to the temperature, on the sea than on the mountains. There is also an increased metabolism shown by the presence in the urine of more urea and sulphuric acid and less uric and phosphoric acid, and the body's weight is increased. These effects, Beneke demonstrated, are produced more by sea-air than sea-baths. The constant movement of the air doubtless has much to do with this. Most observers, with whom Weber agrees, assert that as a rule the rate of the pulse and respiration are lowered on the sea, due without doubt to the great barometric pressure and increased humidity. As a generality, it may be stated that sleep and appetite are increased, and that the effect on the nervous system is that of a sedative. There are of course many exceptions where the opposite results are markedly produced. The continued effect upon those with whom the air agrees is to increase the blood-supply and strengthen the nervous, circulatory, and cutaneous systems. In short, the influence upon suitable temperaments and conditions is that of a sedative tonic.

Therapeutic Application.—The effects of any climate, and therefore sea-air, on pathological conditions and disturbances may be divided into those which are general and those which are special, those which are negative and those which are positive.

In the first place, a removal to the sea ensures the advantage of freedom from mental worry or toil, and from impurities of atmosphere and surroundings, without, however, what is often a practical drawback to sea-voyaging, possible lack of hygiene in the vessel itself.

The general advantages are those of pure air, much ozone, and out-door life. These it shares more or less in common with all health-resorts. Its more special effects are through its humidity and equability and its electrical influence in tranquillizing the nervous system, and secondarily the circulatory and cutaneous systems. It is therefore beneficial where there is much nervous irritability and where degenerative changes are in progress. I have observed benefit from sea-air in many chronic nervous diseases of both old and young where change of structure was or had been progressing, whereas I have yet to see such cases benefited under the extreme opposite of climate—viz. on the mountains. The nervous irritability which accompanies a full habit is usually best suited to a sea climate, while the irritability that is associated with a feeble circulation is more surely relieved at an altitude. With regard to diseases of the heart and great vessels, it may be stated as a generality that they are much more apt to be improved on the sea than on the mountains, though there are notable exceptions to this, as in the experience in the Andes of Dr. Archibald Smith, who saw improvement in cases of aneurism. My own observations in Colorado confirm this. The benefit derived in certain conditions of valvular lesions by mountain-climbing and residence has been demonstrated by Oertel and others. With respect to hepatic affections the question is one that is largely influenced by temperament, which the humidity controls. The man who is made bilious by sea-air is generally of dark complexion and spare habit, in whom inquiry reveals the fact that he feels best in dry and often in frosty weather, while the blond with a tendency to a full habit generally is at his best when the air is humid and also when it is warm. Kidney affections are frequently benefited by sea-air when the temperature is high, by reason of the equability, and in spite of the humidity limiting the relief to the defective organ by the lack of vicarious elimination through the skin. Some renal affections are more benefited on the mountains, where the dryness of the air is of sufficient value to counterbalance the objection of inequability. On the whole, however, these diseases may be said to do better in warm sea-air than in warm mountain-resorts. In regard to scrofulous affections, I was much struck some years ago by the improvement in the children at the Infirmary for Scrofula, which is on the warm sea-shore of Margate, while I was attending there. I have, however, since seen better results in Colorado, and much less disease among the inhabitants. The benefit derived from sea-air in scrofulous affections is probably due to the gen-

eral and negative influences, and not to the special and positive. As regards pulmonary affections, diseases of the air-passages accompanied by much cough and a lack of free secretion from an irritable mucous membrane are apt to be benefited. I found this the case on the coast of Southern California, which I recently visited, whereas such cases do badly on the mountains; and this is true for the most part even when accompanied by tuberculosis, chronic pneumonia, and pleurisy, while, on the other hand, most cases of phthisis are usually better away from the sea.

Island Climates.—By these are understood only the climates obtainable on islands of moderate size: these if at a fair distance from the mainland often enjoy most of the qualities of a pure ocean climate, without the drawbacks of ship-life, and of course are influenced by latitude, ocean-currents, soil, and configuration.

Coast climates partake more or less of the characteristics of both sea and land. They have less equability, owing to the different radiation from land and water, as spoken of before. The humidity may also be greatly lessened by the proximity of deserts, as in Northern Africa and Southern California. Again, the precipitation is often changed considerably. Thus coast climates, though resembling in general qualities the ocean climates, have wide ranges of difference, so that life at the shore, on the sea, and on an ocean island have great contrasts and yet a strong family resemblance.

Inland Climates.—Inland climates of low elevation have certain physical peculiarities, and, occupying as they do a position between sea and mountain climates, have for the most part, like those of the sea, high barometric pressure, lessening with elevation, and more or less humidity, diminishing, as a rule, with the distance from the ocean. The intervention of mountain-ranges, however, such as the Coast Range of California, will cause the precipitation of the moisture of the sea-air, and thus give a comparatively dry air on the land side of the range at only a short distance from the sea. The dryest low inland climates are nevertheless generally found in the interior of the continents, most remote from the ocean. The humidity, again, is modified not only by proximity to the sea, but also to great lakes, rivers, and swamps, and further by the vegetation and quality of the soil. The mean temperature varies, in the main, with distance from the equator, while the variations between day and night, sunshine and shadow, summer and winter, being dependent on the amount of humidity, increase, as a general rule, with distance from the ocean. There are, of course, marked modifications of this, as where desert lands approach the sea or, as referred to, mountains intervene. The air is necessarily less pure and the amount of ozone less than on the sea.

The main division of low inland climates is into moist and dry,

and these again into moist and warm, moist and cool, dry and warm, dry and cool.

The moist and warm combination, when extreme, is altogether unsuitable for therapeutic purposes, giving the hot damp climates where malarial and other fevers, such as yellow fever, abound. Coming between these and the next class are *the moderately moist and warm climates*, which, though generally occurring as coast climates, may be inland also, such as Florida and the coast region of Southern California, the climate of Florida being, on the whole, rather the more moist and warm. These climates act chiefly through their sedative influence upon the nervous system and the mucous membranes, and during their appropriate seasons the moderate rainfall and equable warmth allow of much outdoor life; and they are especially useful in affording an agreeable change in winter for those inhabitants of colder regions who desire for comfort or safety to avoid the rigor of their home climate. Moderately moist and warm climates are also often used by invalids with great benefit. Such climates are found at Rome and in Persia and the Riviera in Europe, and on this continent at Asheville in Western North Carolina (elevation 2250 feet), and at Aiken in Western South Carolina and Marietta and Thomasville in Georgia. The general indications for the therapeutic use of such climates is where the extreme effects of climate, such as are produced in sea- and mountain-air, are undesirable or dangerous.

Moderately moist and cool climates may be termed indifferent, having no marked characteristics, but are often of service on account of their accessibility and pleasant surroundings and encouragement to diversion of mind and body. Many of the mineral springs that are largely used are situated in such climates, as Baden-Baden, Wiesbaden, and Saratoga, and resorts in the foot-hills and sub-alpine places are mostly in this category. In America, Evans[1] places in this group, with a general elevation of 2000 feet, the western slope of the Appalachian chain, the Adirondacks, and the Alleghany and Cumberland mountains. These, owing to their elevation and purity of air by reason of being mostly in uncultivated and sparsely-inhabited regions, have more positively beneficial qualities than the lower places first referred to. Pine forests and the opportunities for sport and camping also add much to their value.

Moist and cold climates are quite unsuited for therapeutic use, being the producers of rheumatic and catarrhal affections, as well as the breeding-ground of much of the phthisis that everywhere abounds.

Dry and warm climates are greatly used by invalids, and often with benefit. Such climates are practically not to be found in Europe. The west coast of Africa, Egypt, and Nubia, the Steppes of Tartary, and

[1] *Phthisiology*, by G. T. Evans, M. D., D. Appleton & Co., N. Y.

on this continent South-western Texas, the inland regions of Southern California, and the less elevated regions of Arizona and Utah, come within this class. Egypt may be taken as a type of the dry warm climates, and of this Dr. Weber writes that he has notes of 24 cases of phthisis, which spent from one to four winters in Egypt; of these, 6 were in the first stage, with 4 cases improved and 2 grown worse; 12 in the second stage, with 6 improved, 3 grown worse, and 3 with no positive change; 6 in the third stage, with 2 improved, 3 grown worse, and 1 no decided change—a total improvement of 50 per cent. of the whole 24. In the first stage 66.6 per cent., second stage 50 per cent., third 33.3 per cent., were improved.

In 10 cases of emphysema with chronic catarrh, 9 improved. In 16 cases of chronic rheumatism, 14 improved. Out of 9 cases of chronic gout, 8 improved. In several patients with long-continued diabetes, who were at or past middle age, improvement was noted. Of 11 cases of albuminuria, 4 improved, 4 remained stationary, 2 grew worse, and 1 died. Some cases of heart disease with bronchial catarrh and digestive disturbances did well; so also did some with neuralgic affections, premature ageing, and nervous exhaustion from mental work or business care.

I visited Egypt several years ago, remaining six months, from October to April, during which time I frequented the hospitals in Alexandria and Cairo. At the latter point I remained some time, making excursions from it, and then spent four months on the Nile, going into Nubia as far as the Second Cataract, during which time I was frequently consulted by visitors and by invalids, both native and foreign. The conclusions I formed of the effect of the climate upon disease confirm what I have quoted from Dr. Weber.

On this continent the regions with an elevation of less than 2500 feet, which are similar to Egypt in climate, have been but little used, and have at present few means of ensuring comfort and resource for invalids. Portions of Western Kansas and Southern Arizona are somewhat similar in climate, more particularly the latter, and, as far as can be ascertained, tend to benefit much the same class of diseases. It is, however, not practical at present to send patients to them, though I have known benefit derived in both where a greater altitude did not agree, and yet dryness was desirable.

Weber says *dry and cold climates* are not yet used therapeutically; he has seen 4 cases of phthisis in the first and beginning of the second stage, when business took them to Labrador, 3 of whom entirely recovered in the course of from four to six years. The fourth was unimproved. All four patients were powerfully-built men, free from other disease and without hereditary taint. Thus, the four cases, Weber says, might be called "selected," and he would not advise the climate

for weakly persons. I had under my care in Colorado a patient of fine physique who had tuberculous ulceration of the larynx and consolidation at one apex. While in this condition, and having the pulmonary symptoms with aphonia and dysphagia, he went on the Greely relief expedition to the North Pole, and while under the influence of the dry cold air all his symptoms improved. Returning to the Eastern States, he got worse, came to Colorado, improved again, his larynx healing, and with all the signs of arrested disease he went back East, and there succumbed to a general tuberculosis, dying ultimately from meningitis. In a less degree, during the winter season the climates of parts of Canada, Minnesota, Nebraska, and Dakota rank in this class. Benefit to cases of pulmonary tuberculosis in an early stage and in robust persons are reported from all of them, but the cases that will do well in such climates do far better for the most part, and more certainly, in dry, elevated regions.

Elevated Climates.—The first in importance of the physical peculiarities of elevated climates is rarefaction, or lessened barometric pressure, while the next peculiarity of importance is coolness of air, with, at the same time, greater direct heat from the sun, especially in winter. The temperature of the air is very slightly raised by sunshine passing through it, for the reason that there is so small an amount of moisture in it. For this reason the sunshine is very hot and the air very cool in elevated climates, and these contrasts are especially marked during the winter, owing to the greater dryness at that season.

The dryness of the air—that is, both the absolute and relative humidity—is low in elevated climates, though the rain- and snowfall is sometimes considerable, and the movement of the air, except in sheltered valleys, is constant and not excessive, though wind-storms are common.

In elevated climates the air is aseptic, for there is very great freedom from inorganic and organic impurities and miasmata. The causes of this are not determined, but they may be due to the following conditions: first, to the low humidity, bacteria and kindred microorganisms thriving better in damper air; second, to the cold nights, destroying many forms of life; third, to the perfect oxygenation, the oxygen not being replaced by other and noxious gases; and, fourth, possibly by the greater energy of the electrical state of the earth and air. However, where unhealthy conditions exist, as in crowded cities with numerous invalids, even at a considerable altitude, the aseptic quality of the air disappears.

The increased light of elevated climates has been shown, by the experiments of Downes, Blunt, and Moleschott, to destroy bacteria and increase oxidation; and there is a relative increase of ozone, which is

presumed to be allotropic oxygen, or, in other words, oxygen in an especially active state.

Positive electricity is also present in a higher degree, and dryness of soil usually exists.

The General Physiological Effects.—The activity of the skin is increased, and it is better nourished and strengthened in an elevated climate, and the heart and vascular system also are probably strengthened. The frequency of the contraction of the heart is certainly increased at the beginning of the stay in such climates, but returns to the natural number of beats after a time. The individual contractions are stronger, and in this manner the strength of the circulation is increased.

The number of respirations is increased at first, but returns to the natural number after a time, and the depth of the inspirations is probably increased. The respiratory muscles are strengthened, and probably also the elastic fibres of the finest bronchial ramifications. The blood in the lungs is also increased in quantity, while the amount of water eliminated by the lungs is usually considerably augmented, and the separation of carbonic acid rendered more free.

As a rule, there is either a transient or permanent increase in the appetite and in the assimilation of nourishment, and consequently an improved formation of blood and nourishment of these organs ensues.

The nervous and muscular systems become stronger in elevated climates, and sleep is generally improved.

General Pathological Effects.—Dr. Ludwig, in his prize essay upon the Upper Engadine, shows that at high elevations there is an increased mortality in the following diseases, which are those most commonly known there: Acute bronchitis, acute pneumonia and pleurisy, catarrh of the mucous membranes of the air- and digestive passages and of the conjunctiva, rheumatic and neuralgic affections; also certain forms of anæmia and cardialgia, which occur in women from unsuitable food and ways of living.

In this region it is rare to find cases of chronic pneumonia, phthisis, hæmoptysis, scrofula, hæmorrhoids, intermittent fever, and similar diseases.

Therapeutic Application.—The difference, writes Dr. Weber, in the therapeutical action of the various elevated climates is very great, varying with their height, latitude, direction toward the points of the compass, and configuration of the surrounding country. It may be said, however, that, as a rule, the character of a mountain climate is stimulating to most functions, and that it has a powerful therapeutic action, although it requires a certain integrity and resisting power of the constitution to attain this desirable effect.

The *diseases which are favorably influenced* by an elevated climate are loss of appetite and disturbance of the stomach from lack of exer-

cise and pure air, with the ordinary consequences, such as anæmia and chlorosis. In chronic catarrh of the throat and bronchial tubes such a climate assists the secretion of mucus. The results of malarial poisoning, as sluggish circulation in the abdominal organs, hæmorrhoids, and hypochondria, are improved, as are also anæmic disturbances of nerve-action, such as neuralgia, slight hysterical conditions, and nervous polyuria. In most cases of nervous and bronchial asthma which do not depend upon emphysema and organic disease of the heart and blood-vessels, and are not complicated with them, benefit is obtained, and sleeplessness from overwork or exhaustion without mental disturbance is overcome. Weakness of the skin, a poorly-developed chest, a tendency to consumption, consumption itself, and scrofulous diseases are improved, though these are generally more benefited at the seashore.

The *diseases which are unfavorably influenced* include most cases of organic disease of the heart and vessels, though a heart moderately enlarged with a weak muscle, even with a bruit, is often improved, and generally much more so than on the coast. Even cases of aneurism of the aorta are often relieved. A notable case of this character, which occurred at Jauja, Peru, 9000 feet above the sea, is related by Archibald Smith.

Atheroma and senile affections generally contraindicate a high climate, and chronic bronchitis with great enlargement of the tubes and much emphysema is made worse. Epilepsy is also usually made worse, though experience on this point is very limited. In cases of lunacy, when there is a tendency to agitation, high climates do harm. They are also unsuitable for rheumatic affections and in the presence of much general debility with inability to bear wind, cold, or change of temperature. Generally, old persons and infants are better on a warm seashore.

Such is the summary of views of the observers at altitudes in Europe and elsewhere. My own observations in Colorado at similar elevations agree very closely with them, though there are some points of difference; but, as they do not much affect the main issues of the question, we will not discuss them.

Diseases in which Climatic Change is Indicated.

The disease must be of a chronic character, though occasionally a change during an acute stage of the illness is called for, as when the heart or nervous system is being unfavorably influenced by the climate in which the invalid is placed. Acute tuberculosis also is often arrested by a suitable change. The most important of the diseases for which change of climate is properly prescribed is tuberculosis, especially that of the lungs. We will therefore proceed to inquire into the influence of climate upon phthisis with regard to its production.

Phthisis.

What are the essentials of a climate for the cure of phthisis? The first and most important, and the one upon which all writers are agreed, is *purity of air*—not necessarily antiseptic air. The air being the chief food of the lungs, which are the parts in which the lesion exists, must necessarily be pure in order to effect an improvement. For this reason we find from the researches of Hirsch, Weber, Evans, Copland, Woeikof,[1] and others that there is least consumption among the people who dwell on mountains or on open and comparatively uninhabited plains, such as the Great American Desert, the African Desert, and the Steppes of Tartary, and on certain islands and sea-coasts. Although there is no zone of freedom from phthisis upon the surface of the land or sea, it being found everywhere, yet, as has been stated, it is relatively rare in the following order—viz.: On certain sea-coasts, on certain islands enjoying as nearly a pure ocean climate as possible, in desert places of wide extent, as found in the interior of continents, in polar regions, and, finally, most rare at elevations and increasing in rarity with altitude. Further, the experiments of Brown-Séquard, Stokes, Trudeau, and others show that when animals which have been successfully inoculated with bacillary matter are kept in confined spaces with imperfect ventilation, they become tuberculous, while those which after similar inoculations are kept in open-air quarters escape the disease.

In regard to *temperature*, Hirsch[2] shows the fallacy of the theory, on the one hand, that consumption is most common in cold or temperate climates, and on the other that it is not common in warm and hot climates; and he further states that "the mean level of the temperature has no significance, as will be seen from the facts already given, and particularly from the statistics of mortality for the frequency or rarity of phthisis in any locality." But it exercises a very decided influence on the course of the disease; for, according to nearly all authorities, in tropical countries, including India, Cochin China, China, the Pacific islands, the Andes, the west coast of Africa, the West Indies, Panama, Guiana, Brazil, and Peru, consumption usually runs a much more rapid and pernicious course than in higher latitudes, the removal of the patient from such a climate as speedily as may be being in fact the only sure protection against a rapidly fatal issue.

During a practice of sixteen years' duration in Colorado, largely among the consumptive visitors, I have observed that in those in whom the disease had developed in warm climates the malady was usually much further advanced in the same length of illness than in those coming from cool climates, and that the tendency in most of the former

[1] *Die Klimate der Erde.*

[2] *Handbook of Geographical and Historical Pathology*, vol. ii.

cases was to run a more rapid course and more frequently to end fatally than in the latter.

Severe and sudden changes of temperature from day to day have no more determining influence, *per se*, than has the absolute height of the temperature. Hirsch refers to the evidence furnished in abundance from numerous places in the more elevated regions of North and South America which are little touched by the disease, although they are subject to very severe fluctuations of temperature. The evidence shows that *variability with dryness of air* has at least no prejudicial influence on phthisis, except, of course, in some special cases; and there are many theoretical reasons, and I believe good practical ones also, as will be shown later, for believing these qualities to be beneficial.

Hirsch has shown that *variability with dampness of air*, when conjoined with frequent oscillations of temperature, predisposes to phthisis, while, on the other hand, *damp heat* has been shown not to have a positive influence in its production, but a very decidedly unfavorable one upon its progress when once established.

Damp cold, however, is proved to be very positively active in the production of consumption, and most injurious to those in whom it has developed; and *dampness of soil* has been incontestably proved by the investigations of the elder Bowditch, Buchanan, Milroy, Pepper, and many others to be a most potent factor in the production and progress of phthisis—very much more so than dampness of air, either hot or cold.

Humidity of the air does not in itself, apart from other factors, apparently produce phthisis: the comparative immunity from consumption among the men of the British navy contrasted with those of the army, and the rarity of the disease upon many islands, such as the Faroe, the Shetlands, the Hebrides, and Iceland, show this. The influence of these climates and of sea-voyages on the disease when developed and active has, however, not been shown by the evidence of others or by my own observation to be beneficial, removal from the sea being generally of most advantage. Where benefit has been received in a sea climate, it would appear probable that it was owing mainly to the great purity of the air or the elimination of unsanitary conditions and hurtful occupations, as when an overworked citizen takes a sea-voyage or a Bostonian is sent to such a climate as the Isle of Shoals, or a Philadelphian to Atlantic City. Therefore, it is fair to assume that the beneficial influence of humidity upon phthisis, apart from other climatic factors, when it occurs, is purely negative. This does not, however, prevent the possibility of its being of positive benefit in occasional cases of phthisis in which the accompanying conditions of the circulation, nervous system, or mucous membranes demand a damp climate.

Dryness of air, on the contrary, has been known to be of positive benefit to the consumptive. The excellent results obtained from desert air (apart from altitude, which we will consider later) are too well known to quote at length. The benefit derived from the Steppes of Tartary is often mentioned, and I myself have, while on the spot, noted remarkable results produced by the climate of Upper Egypt and in Arizona and the Mojave Desert, lying behind the littoral of Southern California. Some years ago, while practising in London, I noted great improvement in the general and local signs of phthisis in several cases of consumption which were tending to deteriorate, after they had been employed for several months as shampooers in the Turkish baths, where they lived for most of the twenty-four hours in a very dry and superheated air. That the dryness, and not the heat, was the cause of the improvement may be fairly inferred from the fact that hot moist climates are not beneficial; and I may add that, from inquiries I have made in Egypt and elsewhere, where the so-called Russian or hot vapor-baths are in vogue, consumptives are very properly warned against their use.

With respect to the rarity of phthisis in dry low climates Hirsch writes as follows: "There are few countries of the world so characterized by uniformity of temperature and comparative dryness of the air as the inland districts of Lower Egypt and the valley of the Nile in Central and Upper Egypt—regions in which phthisis, according to all observers, is very uncommon. On the other hand, as we have already seen, localities on the coast, such as Alexandria, Damietta, and Port Saïd, with a moist climate and a great range of temperature, are much more subject to the disease. The same relation between the sort of climate and the number of cases is found in the interior districts of Algiers on the one part, and the coast-belt of that country on the other. In India, says Hunter, the localities specially distinguished by dryness of climate (and uniformity of temperature), be they on the plains or among the hills, are least affected by phthisis; and the same relationship may be discovered in Java, in the Gulf States of the American Union, in Mexico, in Guiana, and in many islands of the West Indies. It is a probable conjecture that the way in which the climate affects the amount of disease is through the particular states of the weather (high degree of atmospheric moisture along with great variations of the thermometer), causing catarrhal affections of the bronchial mucous membrane and the after-effects of the same—that the climatic influence, accordingly, is in all probability a real predisposing factor in the development of phthisis. It is from the same point of view that we may explain the beneficial effects of the climatic treatment of consumption—a treatment which consists in withdrawing the subjects of phthisis

or those who are threatened with phthisis from these harmful climatic influences."

In crediting dryness of air, *per se*, with a beneficial influence upon phthisis, we must not forget that some share of the credit at least belongs to the other necessary accompanying factors of a dry atmosphere—namely, more powerful sunlight and heat, less depressing cloudy weather, cooler nights and shade, and a higher electric tension of the body. What is also of prime importance is the greater opportunity for exercising and resting in the open air and while the invalid is in the house, the windows being open by day and by night.

In regard to *altitude*, observers have differed as to the least degree of elevation at which its special characteristics are manifested, some placing it as low as 1500 feet, but most writers at 2500 feet, which is probably the more correct. What Hirsch writes concerning the relative immunity of great altitudes, and his theory of the cause, are so pertinent and valuable that I will quote him at length: "The observations published by Archibald Smith and Tschudi as to the extreme rarity of phthisis on the high plateaus of the Andes in Peru, and as to the good effects upon the phthisical of a residence thereon, were the first statements to direct general attention to the comparative immunity from consumption of regions at a great elevation. Further inquiries in the same direction have confirmed the general fact, but they have in part also given color to an opposite conclusion, so that the question may be said to be still *sub judice* for those who would decide it absolutely and without regard to accessory circumstances.

"It is not to be denied that phthisis does occur at the highest inhabited spots on the globe, and that it is rare in many places situated on low plains; none the less, it is an incontestable fact that consumption is, *cœteris paribus*, much less frequently met with at high-lying places than in those at a lower elevation or on the sea-level. Not only so, but the number of cases stands in some kind of definite proportion to the degree of elevation, while the exceptions to the general rule find satisfactory explanation in other etiological factors coming into play at the same time."

The rarity of phthisis at high elevations is well shown in the returns of sickness from that most extensive of the earth's mountain-chains which runs along the whole Pacific coast of the Western Hemisphere. For the Rocky Mountains of North America we have evidence of the fact from a number of places in the Territories situated toward the southern end of the range, such as New Mexico, Arizona, Colorado, and also Utah. In like manner, all the authorities speak of the rarity of the disease on the plateaus and mountain-slopes of Mexico, Guatemala, Salvador, Costa Rica, and Panama (for example, on the Cordilleras of Veragua and Chirigui). From Bogota, in New

Granada, Holden writes that he did not see one consumptive person in the hospitals of the town during a prolonged residence there. Referring to Quito (Ecuador), Gayraud and Domec say: "Notre experience personelle nous permet d'affirmer, que la phthisic y est tellement rare qu'elle n'y existe pas, au moins comme maladie prenant naissance dans le pays lui-même. . . . . Le fait est donc pour nous indubitable, on ne devient pas phthisique à Quito." For the Peruvian Andes we have the statements of Smith and Tschudi, already mentioned. During a year's stay on the Cerro Pasco the former saw only one case of consumption, and that was in a woman who had come from Europe.

"There is no doubt," says Andrew, "that as regards altitude the prevalence of phthisis at considerable heights, although instances of it do exist, is exceptional; and Burkhart mentions that he had not seen a single case of phthisis during a period of three months among the Europeans occupied at the mines in Mexico.

"In those parts of the Argentine Republic that are within the limits of the Andes the influence of high elevations upon the rarity of phthisis is observable as far down as Salta; it is still more obvious in the elevated valleys on the western side, as well as on the Bolivian plateau at Chuquisaca, Cochabamba, Potosi, and other places. In the mountainous parts of Guiana also consumption is almost unknown."

In the Eastern Hemisphere this immunity from phthisis is shown most decidedly on the plateau of Armenia, where the disease is found almost solely among those who have come from less elevated places; also on the table-land of Persia, where it is extremely rare, and among the natives of the country almost unknown; on the northern and southern slopes of the Himalaya, at the elevated points of the Western Ghats, on the Nilghiri Hills, on Mount Abu (4000 feet) in the Aravalli range, and in Nearer India; on the plateau of Abyssinia and on those of Southern Africa.

In Europe a certain rarity of phthisis begins to be noticeable even at comparatively small elevations, as in the Iser range, on the northern spurs of the Carpathians, in Upper Silesia, on the elevated plain of Thuringia, in the Upper Hartz, and in the Spessart. Writing of Upper Silesia, Virchow says: "Although I have seen an exceptionally large number of sick persons of the poorer class both in town and country, at their homes and in hospital, yet there has not come under my notice a single case of phthisis; and the statements of the medical men bear out the notion that the disease is rare. In the Upper Hartz consumption is so unusual that Brockmann, during a practice of many years and extending to eighty thousand sick persons, found only twenty-three phthisical patients, of whom only fourteen had been born in the Upper Hartz; in the lower valleys the malady is more common, but the high plateau is almost exempt." In Spessart, according to Virchow,

phthisis is not so rare, although in the larger villages he met with only an occasional case, and the registers of deaths rarely contained the entry of consumption or decline. I shall add here the interesting note by Gross, that consumption is almost unknown in Briançon (Hautes-Alpes), the most elevated town in Europe (1306 metres, or 4285 feet), although the place is a small fortress with a good deal of filth and a number of industries. Statistical inquiries, such as have been carried on in Saxony, Baden, and Switzerland, on the amount of phthisis in the elevated places as compared with low-lying places close at hand (due regard being had to any differences in the mode of life), have confirmed the law of immunity of the more elevated places from phthisis which had been deduced from the study of the higher elevations by themselves. The following is Merbach's table for Saxony, based on a period of three years from 1873 to 1875, and including only those towns with upward of five thousand inhabitants, and only the ages between fourteen and sixty years:

Altitude in Metres (= 3¼ feet).	Deaths from Phthisis within the Limit of Age.
100 to 200	In 1000 . . . . . 4.9
200 " 300	1000 . . . . . 3.3
300 " 400	1000 . . . . . 3.2
400 " 500	1000 . . . . . 3.5
550 " 650	1000 . . . . . 3.3

Merbach concludes as follows: "There is certainly nothing shown here of any marked influence due to the elevation of the various localities, or of such an influence as would cause the number of deaths from phthisis to decrease *pari passu* with the increase in elevation. A result of that sort was indeed not to be looked for, inasmuch as the several towns are subject to other influences—and some of them noxious ones, such as the occupation of the inhabitants, the density of the population—which are capable of neutralizing the effect of an elevated location. At the same time, even in instances before us, the good effects (otherwise sufficiently proved) of a high situation upon the prevalence of consumption can hardly be overlooked whenever we begin to compare the villages in lowest situation with those in the highest. . . . . The contrast comes out with special clearness when the averages calculated for towns situated at one and the same level are compared together."

Corval has worked out this relationship from the Baden bills of mortality over a period of four years (1869–72), including in his total, as he was bound to do, all those cases in which the cause of death was given as tuberculosis, "chronic pneumonia," or "phthisis." He distinguishes six groups of localities according to elevation:

Table of Mortality from Phthisis in Baden, according to Elevation.

Elevation in feet.	No. of towns or villages.	Population, average of four years.	Death from phthisis per 1000.
I. 330–1000	750	933,773	3.36
II. 1000–1500	337	224,210	2.75
III. 1500–2000	160	81,066	2.60
IV. 2000–2500	190	104,289	2.75
V. 2500–3000	97	59,155	2.33
VI. Above 3000	47	20,367	2.17

"In order to ascertain what effect is produced upon the death-rate from phthisis by density of population, industrial pursuits, and other things peculiar to towns, we may make a calculation of the mortality according to the size of every town or village in Baden, using Corval's figures: we shall find, accordingly, that it is 3.12 per 1000 inhabitants for the whole of Baden, 3.00 for villages of 3000 and under, and 3.49 for towns from 3000 to 10,000, and 4.56 for towns with more than 10,000 inhabitants. If, now, we arrange the places that are respectively over and under 3000 population in two columns, classifying them in six groups according to elevation, we shall get the following table of the death-rate from phthisis:

Altitude-Groups.	Under 3000 Population.	Over 3000 Population.
I.	3.11	4.05
II.	2.73	3.08
III.	2.49	4.99
IV.	2.71	4.72
V.	2.29	3.06
VI.	2.17	

In the series with less than 3000 inhabitants the favorable influence of increasing elevation is quite obvious, but in the second column of death-rates it will be seen that the benefit is in some circumstances more or less neutralized by detrimental factors belonging to the social and industrial life of the large centres or the towns. Still, from the facts, such as they are, we may adopt Corval's conclusion, that "cases of phthisis decrease with increasing elevation; or, in other words, in mere increase of altitude we may discover one of the most important factors in checking the development of consumption."

Müller's inquiries into the effect of elevation upon the prevalence of phthisis in Switzerland have led him to the same conclusion, although the results, as he is careful to explain, can be said to be only approximately correct, for the reason that the data at his service were not free from a good many omissions and errors. He distinguishes three groups of places: (1) Those in which from 43 to 63 per cent. of the inhabitants follow some industrial occupation (cantons of Outer Appen-

zell, Glarus, Neufchâtel, town and country divisions of Basel, and Geneva); (2) where the industrial part of the population reaches from 31 to 43 per cent. (cantons of Zurich, St. Gall, Thurgau, Zug, Inner Appenzell, Aargau, Schaffhausen, Solothurn, Bern, Ticino); and (3) the agricultural cantons, where the industrial population is only from 13 to 26 per cent. of the whole (Lucerne, Schwyz, Unterwalden, Vaud, Freiburg, Grisons, Uri, Vallais). Grouping the places in each of these divisions according to their elevation within a limit of 200 to 1800 metres (650 to 6000 feet), we get the following table of death-rates:

Table of Death-rates from Phthisis in Swiss Towns and Villages.

Elevation (in metres).	Industrial Cantons.	Mixed Cantons.	Agricultural Cantons.	Average.
200–500	2.7	1.85	1.4	2.15
500–700	3.0	4.55	1.2	1.9
700–900	1.35	1.7	0.7	1.0
900–1100	1.5	1.9	1.9	1.2
1100–1300	2.3	2.3	0.7	1.9
1300–1500	. .	1.4	0.6	0.8
1500–1800	. .	1.3	0.7	1.0
Average	2.55	1.7	1.1	1.86

Müller concludes from these facts "that in Switzerland consumption can be shown to decrease as we ascend; that the malady does occur, although rarely, at the highest inhabited spots; that the lowest localities have on the average about twice as many consumptives as the highest, and very much more than that if the cases where the phthisis had been acquired elsewhere be subtracted; that the decrease of phthisis with ascending elevation is, however, neither constant nor proportional; and that the irregularities and fluctuations which are noticeable are owing mostly to the position in the social scale, inasmuch as the industrial group of places show the irregularities most, and the mixed groups on the whole a regular decrease with height, while the agricultural groups touch their lowest death-rates at a comparatively small elevation.

"What the minimum elevation is that a locality must have before it feels the good effects of altitude on the prevalence of consumption is a question that cannot be answered with certainty from the facts before us. Gastoldi puts it at 600 to 1000 metres (2000 to 3300 feet); it seems to me, however, that a notable decrease in the disease can be shown to occur at as small an elevation as 400 or 500 metres (1500 feet), provided other circumstances are favorable. But any immunity from phthisis due to the height of the place does not come out decidedly until we go to elevations so great as to be uninhabitable in temperate climates like that of Europe. We must go to the equatorial parts of the world to study the sanitary effects of altitudes ranging

from 2000 to 3000 metres (6000 to 10,000 feet), and, inasmuch as the question is one of populous places and the seats of industry, we must take the large towns on the plateaus of the Andes in Central and South America, such as Puebla, with 80,000 inhabitants and at an elevation of 2300 metres or 7500 feet, Mexico (320,000 inhabitants, 7500 feet), Quito (60,000 inhabitants, 9300 feet), Bogota (40,000 inhabitants, 8500 feet), Chuquisaca (25,000 inhabitants, 9800 feet), Cochabamba (40,000 inhabitants, 11,000 feet) and Potosi (20,000 inhabitants, 13,000 feet). In all of these, which are to some extent industrial towns, or at any rate much occupied with trade and commerce, and by no means models of good sanitation, consumption, according to the unanimous testimony, is either rare, or, among the natives, it does not occur at all. And that is a proof that the influences which go with a very considerable altitude have the power to overcome those detrimental things that arise from a bad kind of hygiene and social life, in so far as these tend to produce consumption."

Opinions differ as to the nature of the influence of altitudes. Some trace it to the freedom of the air from decomposition-products, dust, and the like; others to the dryness of the air and soil; both of which opinions seem to me to be overthrown by the facts given above, as well as by the circumstance that the immunity from consumption occurs equally on dry and on damp plains, or in mountain-valleys abounding in lakes and pools, provided only that they stand at a considerable elevation. The only explanation that I can offer, and one to which I shall hold until something more satisfactory presents itself, is that people who have been born and brought up at great elevations have been always under the necessity of making frequent (or perhaps deep) inspirations as a consequence of breathing a rarefied atmosphere—that they are continually practising a kind of pulmonary gymnastics, from which there proceeds a vigorous development of the breathing organs and a greater power of resistance on their part to noxious influences from without. "After looking at the bustle of traffic in towns like Bogota, Micuipampa, Potosi, at elevations of 8000 to 12,000 feet," says Boussaingault; "after witnessing the strength and marvellous skill of the toreadors in the bull-fights at Quito, 9000 feet above the sea-level; after seeing young and delicate girls dancing a whole night at places almost as high as Mont Blanc, on which the celebrated Saussure had hardly strength enough to use his instruments of observation, and his hardy guides fell down in a swoon as they proceeded to dig a hole in the snow; when we remember, finally, that a famous battle of Pichincha was won almost in the altitude of Monte Rosa,—I think that you will agree with me that man can become adapted to breathing the rarefied air of the very highest mountains." I will readily grant that many of the accounts of embarrassed breathing experienced by natives

of the plains on ascending very high mountains are exaggerated; and I must confess that in my own case, after resting for a short time at elevations of ten thousand feet and upward, I was conscious of no considerable want of breath, or did not become aware, at least, of any need for quicker and deeper inspirations. At the same time, it is not to be denied that the atmosphere at elevations of ten thousand feet, especially in a warm climate, is rarefied to the extent of more than one-third of its volume at the sea-level. The quantity of oxygen contained in it is therefore considerably diminished, and a man must take in a larger quantity of air in a given time, or must inspire oftener than on the plains, so as to cover his requirements for oxygen. To that assumption no well-grounded objection can be raised, whether from the side of physics or of physiology; and there is equally little reason why we should not assume that those who have been born and have lived all their lives under such circumstances will have had their breathing organs powerfully developed. I do not hesitate, therefore, to believe that the reason of the immunity from phthisis enjoyed by the residents of elevated places is the influence which a continuous residence in a rarefied atmosphere exercises over them.

"On the other side, we may thus further explain the exemption from phthisis of many parts of the world by reason of their favorable weather-conditions and the consequent rarity of all pulmonary affections therein. The immunity from consumption enjoyed by natives of elevated regions seems to me to be referable to a peculiarly strong development of their breathing organs, and a corresponding power of resistance in them to noxious influences from without; it is proved that this is now not at all an affair of 'purity of the atmosphere,' as some have supposed, by the fact that the state of hygiene in the towns of Ecuador, Bolivia, and Peru, situated at great elevations, is by no means distinguished for its excellence, for cleanliness in the houses or streets, adequate ventilation of the rooms, and the like."

There is little to be added to this exhaustive and masterly array of facts and reasons setting forth the inhibitory influence of altitude upon phthisis. In Colorado, to which my personal observations upon the influence of the altitude have been mostly confined, the native population is too small and youthful to gather any statistics, but living as I have done for the past sixteen years among a people of whom perhaps 30 per cent. came to the country with tuberculosis, and not a few of whom live under unhygienic conditions in crowded lodgings, and where free expectoration is carelessly practised, I know of only four cases of phthisis which could be fairly assumed to have originated in Colorado. Let us now see what is known of the influence of altitude upon phthisis, when developed, as compared with the effect of other climates.

Comparative Results of the Treatment of Phthisis by Climate.

I have collected together for comparison in the tables which are appended the broad results of all reports I have been able to obtain, and they are, I think, sufficient to show the general trend of the climatic influences brought to bear upon the disease.

Table I. shows the results of treatment in low climates (less than 2500 feet above sea-level) in two groups—the first in open resorts, the second in closed resorts—that is, sanitariums; Table II. in elevated climates, above 4500 feet, all in open resorts. Each table gives the name of the reporter, the number of cases reported on in all stages, the percentage of cured, next of cured and improved combined under the heading "Benefited," then the percentage of those in the first stage, after which follows the percentage of cured and of cured and improved together, and finally the place where treated. Other details are purposely omitted, in order to bring out more clearly the general curve of the results. The total number of cases upon which the statistics are founded is as follows: Treated at low elevations in open resorts, 1809 cases; in sanitariums (also at low elevations), 2383 cases, making a total treated in low climates of 4192 cases, while a total of 790 cases were treated at an altitude. These tables, therefore, are based on a grand total of 4901 cases. Table III. gives a comparison from the combined percentages of the several groups.

By the terms "cured and improved" all observers mean that there has been a total absence of all symptoms, both local and general, for a reasonable interval of time, with general good health. In some instances, doubtless, sufficient time had not been allowed to elapse to prove the completeness of the cure. In spite of this, which occasionally makes the percentage too high, as a cure is something positive, the discrepancies between the observers must be much less in this than in the case of the improved class, the latter term being more indefinite, and necessarily embracing many whose future is uncertain, and probably also several in whom the results are not fully known, they not being traced up to date, while it is not likely that any would be placed in the cured class unless the observer's knowledge of their condition was positive and not merely inferred. However, if some of the improved class ultimately ranked with those who became worse, on the other hand few could also probably later be classed with the cured, and the proportion of each would undoubtedly be much the same relatively to the general average of cured and worse. The percentage of cured and improved of the total number of cases treated has a defect, when comparison is made between each group, on account of the variation in the extent of mischief in each case, no note being taken of the

amount, but only of the stage of the disease. However, when several groups are taken together, embracing a considerable number of cases, the tendency for the average proportion of those slightly and seriously affected to be about the same all the world over, no doubt largely mitigates this defect as far as comparison is concerned. Unfortunately, many of the reports do not give the results by stages, although here, again, there are, in addition to the differences in classifying under the heads cured and improved, as already referred to, the differences in the gravity of cases coming under the head of the first stage, as no note is made of the amount of the disease or the general health of the patient when first coming under treatment. However, taking together a large number of first-stage cases from various sources, the general law of averages comes in to modify this objection. In my experience the great difficulty in getting at the real truth of the results lies in tracing up the patients after they had left one's hands. In the case of the sanitariums the reports for the most part are made on patients treated up to the end of the year and reported on in a few weeks or months after its termination. Remembering how often relapses come, and how, to speak positively of the results, a case of phthisis must be followed for several years, I cannot but feel that the sanitarium reports, though doubtless true in their general tendency, are too optimistic, owing to the short space of time that the patients were under observation. I will now briefly refer to the special features of each report.

Reports of Low Climates, Open Resorts.—1. Dr. C. B. Williams, late of London, in his day one of the greatest authorities upon phthisis, and the father of the eminent Dr. C. Theodore Williams, reports 1000 cases. The elder Dr. Williams' cases were all taken from the wealthy classes, and therefore are in that sense selected; and this no doubt exerted a favorable influence upon the results through the patients' intelligence and ability to take care of themselves. They were otherwise selected only in so far as those alone were taken in whom the results could be verified. These 1000 cases, extending over twenty-two years, received the best climatic treatment of the day, exclusive of altitude. They sojourned in many parts of the world, though mostly in Europe.

2. The late Dr. Austin Flint of New York reports 670 cases, and he certainly enjoyed on this continent a reputation and opportunities in the treatment of phthisis equal to those of Dr. Williams in Europe. His studies of phthisis are some of the most valuable we possess, especially of its natural history. His cases were taken chiefly from the well-to-do class, though not as exclusively as Dr. Williams', and his patients did not use change of climate as extensively. His 670 cases extended over a period of thirty-two years, but they are not traced up as fully,

and the only statistics he gives is 44 cases of recovery. He implies that the recoveries—that is, the cures—were about 7 per cent. of the whole number where the results were known.

3. The Brompton Hospital for Diseases of the Chest reports 20 cases of phthisis which were sent out to the island of Madeira for the winter of 1865–66, and the results noted on their return to England: 2 are reported as improved, and 7 slightly so; none cured. These results were considered so discouraging that it practically prevented the sending of consumptives to such warm damp climates.

4. Dr. Hermann Weber of London, one of the first authorities on medical climatology, as has been mentioned in the section on warm, dry inland climates, reports on 24 cases which spent from one to four winters in Egypt; he does not state that any were cured, but 50 per cent. were improved.

5. Dr. D. H. Geddings of Aiken, S. C., reports on 69 cases who passed several winters in Aiken: how long a period they were under observation I do not know, but the fact that the results are so much more favorable than any others from low elevations or similar climates makes one think that the time may have been too short to make these figures reliable for close comparison. I do not know, either, how many were in the first stage.

6. Dr. H. A. Johnson, late of Chicago (6 cases). In the *Transactions* of the American Climatological Association for 1891 is published a paper by Dr. Johnson entitled "The Modification of Tuberculosis by Climate: Report of Cases," in which he reports upon 25 cases of pulmonary tuberculosis, 6 of whom spent more or less time in California and 19 in Colorado; the latter I have placed in the group for Elevated Climates. The 25, he writes, "embrace every case which during about three years, from 1872 to 1875, went to the Western States or Territories, and of which I was able to obtain any subsequent history. . . . . In this series there is not one later than 1875."

A short outline of each case is given, but the stage of the disease is not defined precisely; most of them, however, are easily grouped from the description. And those put as in the first and third stage are undoubtedly correct, while of those placed in the second some may belong to the first, none being so described but where signs of deposit are mentioned and when the statement that there is no cavity follows. I have concluded, since this is only made occasionally, that where it is done it is because there were some moist râles, showing softening had begun. The percentage of favorable results in the six cases is unusually high, but as I could obtain no other reports while recently visiting California, it is not possible to know whether these are average results or exceptionally good ones. Although the number

of cases is so small, the high reputation of the reporter makes them valuable.

The following are sanitarium reports:

7. The late Dr. H. Brehmer of Görbersdorf, whose magnificent institution is the parent of modern sanitariums for phthisis, reported in 1888 on 700 cases treated during the previous year (1887) with 13 per cent. cured, and 53 per cent. cured in the first stage. The climate is medium and slightly elevated.

8. Dr. Dettweiler of Falkenstein, a former resident of Brehmer's, and proprietor of an equally fine establishment, reported in 1888 on 1022 cases treated up to the end of the previous year, giving similar results. The climate and elevation are similar.

9. Dr. E. L. Trudeau of Saranac Lake reports on 146 cases treated in the sanitarium at Saranac Lake (elevation 1752 feet) in the Adirondacks, up to the end of 1888, the report being made in 1889. There was thus no margin of time to test results in the later cases.

10. Dr. Karl von Ruck of Asheville reports on 515 cases treated in his sanitarium up to the end of 1889, and which were reported in the following July, an interval of only six months after the last cases. The small proportion of first-stage cases is noticeable, and the percentage of cures among them is 50 less than Dr. Brehmer's. From what I can learn, however, the cases generally were worse off on admission.

Turning now to the results obtained in elevated climates, the only reports I could obtain were as follows:

11. Dr. Hermann Weber of London reported on 106 cases, nearly all of which were treated in the High Alps, with the results as shown in Table II. His patients were of a similar class to those of the Drs. Williams, and therefore in a sense selected.

12. Dr. Theodore Williams of London reported on 141 cases treated in the High Alps (with 4 exceptions, which were treated in Colorado and New Mexico and in the South African highlands). They were all of the wealthy class, and so far resembled Dr. Weber's selected cases.

13. Dr. Charles Denison of Denver reported on 202 cases treated in Colorado. He does not give any cures, but reports his best results under the head of "much improved." As this is 47 per cent., which is much above the percentage of cures by other observers, it is probable that many of these should be deducted to arrive at his proper percentage of cures; and he writes me that he estimates 10 per cent. should be deducted to give the approximate percentage of cures. I have therefore inserted this percentage, which, without being accurate, throws additional light on the general conclusions.

14. Dr. S. A. Fisk of Denver reported on 100 cases treated in Colorado. Unfortunately, he too does not report on cures, but also puts his best results under the head of "much improved;" and this reaches the still higher figure of 50 per cent. From what he informs me, I judge that his actual percentage of cures was about 15 per cent. less than this, and for the purposes of comparison I have so recorded it.

The author of this article at the meeting of the American Climatological Association held in Denver, September, 1890, reported on 141 cases of phthisis which he had treated in Colorado during the previous sixteen years. The first visits were paid between January 1, 1875, and January 1, 1888, leaving in no instance an interval of less than twenty months, and in all but a few from two to fourteen years had elapsed before the report was made. The results were all carefully traced up to date, and this with the interval of time indicated justified him in believing the results to be very near the exact truth. The cases were not selected, except so far as only those were taken in whom the results could be verified at or near the time of making the report. These were placed in the tables in the order as obtained, and when the desired number of 141 was reached no further search was made. This number was taken, and the particular system of reporting followed, in order to make an easy comparison of the results obtained by him in Colorado with those of Dr. Theodore Williams in the Alps. The author's report, though not giving the results of all cases treated, gives a fair sample of them. The results resemble those of the other reporters of altitude treatment, though not as good in results at most points. Dr. E. T. Williams' percentages are all higher. This I believe to be due mainly to three causes, the first being the greater proportion of first-stage cases —64.53 as against 43.37; second, the better material both as regards the personal equation and the existence of complications; and third, the shorter previous duration of illness, as shown in the original records. With respect to the personal equation, Dr. Williams' patients were all well-to-do Englishmen, who all could, and most would, take care of themselves, while mine were from all sorts and conditions of men. Apart from their circumstances, however, my experience in practice, both in London and at Colorado Springs, convinces me that whatever are their relative merits in other respects, the English make much better patients than the Americans. The third cause, being the longer interval of time before the report was made, accounts for the less favorable results in my reports. Space will not permit me to pursue the analysis further. I may mention, however, that in my original report I submitted abstracts of the case of each of the 141 patients in accordance with the plan of Dr. Williams, and they are published in the *Transactions* of the American Climatological Association for 1890.

Results of Climatic Treatment of Phthisis.

TABLE I.

In Low Climates (less than 2500 feet).

Reported by—	Open Resorts.						Where Treated.
	All Stages.			*First Stage.*			
	No. of Cases.	P. C. Cured.	P. C. Benefited.[1]	P. C. 1st Stage.	P. C. Cured.	P. C. Benefited.	
Dr. C. J. B. Williams . .	1000	3½	44½	67.	5.	45.	Various low climates.
Austin Flint	670	7.	. . .	. . .	. . .	. .	Various low climates.
Brompton Hospital . . .	20	. . .	45.	. . .	. . .	. . .	Madeira one winter.
Dr. Hermann Weber . .	24	. . .	50.	41½	. . .	67.	Egypt one to four winters.
Dr. W. H. Geddings . . .	69	19.	61.	. . .	. . .	. . .	Aiken, S. C., during winters.
Dr. H. A. Johnson . . .	6	50.[2]	67.	66½	50.	75.	California.
			Sanitariums.				
Dr. H. Brehmer	700	13.	. . .	. . .	53.	. . .	Görbersdorf during 1887.
Dr. P. Dettweiler	1022	13½	23.	. . .	. . .	. . .	Falkenstein up to 1887.
Dr. E. L. Trudeau . . .	146	11.	54.	. . .	. . .	. . .	Saranac up to 1888.
Karl von Ruck	515	11½	. . .	15.	24.	45.	Asheville up to 1890.

[1] "Benefited" includes the cured given in the column preceding and all others whose condition was on the whole improved.

[2] It will be noticed that these percentages are much higher than the others in the table, suggesting that, owing to the small number of the cases, some accident in result has had undue weight.

TABLE II.

In Elevated Climates (4500 feet and upward).

Reported by—	Open Resorts.						Where Treated.
	All Stages.			*First Stage.*			
	No. of Cases.	P. C. Cured.	P. C. Benefited.	P. C. 1st Stage.	P. C. Cured.	P. C. Benefited.	
Dr. Hermann Weber . .	106	36.	75.	66.	51½	64.	Alps.
Dr. Theodore Williams .	141	41.	75.	65.	63.	90.	Alps.
Dr. H. A. Johnson . . .	19	37.	79.	47.	44½	78.	Colorado.
Dr. Charles Denison . .	202	37.[1]	80.	37.	75.	92.	Colorado.
Dr. S. A. Fisk	100	35.[2]	67.	42.	66.	91.	Colorado.
Dr. S. E. Solly	141	35½	67½	44.	58.	87.	Colorado.

[1] Dr. Johnson's 19 cases all went to Colorado, except one to Western Kansas, the climate in the latter place being like that of Colorado, as the average elevation is 3500 feet.

[2] Denison in his original reports did not give any as cured, but 47 per cent. much improved. He estimates, however, that a deduction of 10 per cent. from this would give the approximate number of cured. The same deduction is made in the first-stage cases, changing "85 per cent. much improved" into 75 per cent., as shown in this table.

[3] Fisk, like Denison, in his original report did not give any as cured, but gave 50 per cent. much improved. From a recent communication that I have had with him, if 15 per cent. be deducted from this it will probably give nearly the number of cures; and this applies to the first-stage cases also, where he gave 81 per cent. as much improved.

TABLE III.

[1] *Comparison between Open Resorts and Sanitariums in Low Climates.*

	All Stages.			*First Stage.*		
	No. of Cases.	Cured.	Benefited.	No. of Cases.	Cured.	Benefited.
Open resorts in low climates . . .	1724	6 p. c.	46 p. c.	625[2]	5 p. c.	45 p. c.
Sanitariums in low climates . . .	2443	13 "	27½[3] "	89	31½ "	45 "

[1] The number of cases in each report has been added together and divided by the number cured or benefited under the different heads, and the percentage arrived at in this way (and not by adding the percentages together and dividing by the number of reports); where the reports omit the number of cured, benefited, or in the first stage, this particular total number of cases is not taken. Thus these percentages represent the percentage of the total number of cases reported under the several heads.

[2] As shown in Table I., only three of the observers give the number benefited in the first stage, and only two the number cured. For this reason no reliance can be placed on the next figure, "5 per cent. cured," as being the true percentage of the total cases, and it is obviously lower than is the real percentage.

[3] That the total number benefited in sanitariums is actually less than in open resorts, as is shown here, is difficult to believe; yet Dr. C. B. Williams reported 44½ per cent. of his 1000 cases treated in open resorts as benefited, while Dr. Dettweiler reported only 23 per cent. benefited out of the same number treated in his sanitarium. This suggests that there may be a considerable difference between them in the use of the term "improved." The only other of the sanitarium reports from which the benefited could be obtained was Dr. Trudeau's, in whose 146 cases 54 per cent. were benefited; but even this percentage is exceeded by Drs. Geddings and Johnson in open resorts, and nearly equalled by Dr. Weber, though the total number of cases reported by these three observers is less than a hundred, while Dr. Dettweiler's are over a thousand.

TABLE IV.

Comparison between High and Low Climates.

Low Climates.[1]					
All Stages.			*First Stage.*		
No. of Cases.	Cured.	Benefited.	No. of Cases.	Cured.	Benefited.
4167	10 p. c.	36 p. c.	714	20 p. c.	44 p. c.
High Climates.					
709	36½[2] "	74 "	350	62 "	84½ "

[1] These percentages are obtained by taking all the totals in the reports from low climates, both of open resorts and sanitaria, and treating them in the same way as in Table III.

[2] It will be observed that the percentage of cured in high climates is, relatively to low climates, higher in all stages than in the first stage alone. Why this should be so is not easy to explain. It would be probably expected that it would be relatively higher among the first-stage cases than among those at all stages. But, as is shown, there are 3½ per cent. more cured in high climates than in low, taking all stages together; while taking the first-stage cases alone there are but 3 per cent. more. This may be explained by the fact that, leaving out the first-stage cases and taking the second and third stages together and comparing them, we find that there are 3½ per cent. more cases cured in high than in low climates (the percentages being 3½ per cent. in low and 12 per cent. in high). This shows that, although absolutely there are more first-stage cases cured at an altitude, yet there are relatively ½ per cent. more of the advanced than of the early cases cured. Quite a number of the first-stage cases (of limited disease) will, as we know, get well under even the most unfavorable climatic and hygienic conditions, whereas it is a rare thing to hear of the cure of those markedly affected in whom softening has commenced under any but the most favorable conditions; and even then, as these tables show, the number is only 3½ per cent., except in high climates, where it is 12 per cent.

Can patients cured at an altitude return to low climates? To answer this question I will quote from my paper on the "Results of Treatment of Pulmonary Consumption in Colorado:" "Of the 141

patients, 59—that is, 41.84 per cent.—left Colorado. Of these, 45—that is, 61.44 per cent.—are to-day in the improved class, as they were on leaving, while 38.31 per cent. were worse on leaving or became so since. Of the 59 who left, 33 had been in the first stage, 26 in the second or third. Of the 82 who remained (58.15 per cent. of the whole number), 82.76 per cent. are in the improved class, while only 17.24 per cent. are worse. This indicates that several of those who went away might have been improved by a longer or permanent residence. On the other hand, of those who remained and improved there are undoubtedly several who are well enough to leave (but prefer to remain), 19 being permanently cured; and from my knowledge of their condition I believe it fair to assume that about 50 per cent. of the total number coming to Colorado can return to their homes to live in safety, providing of course the danger to them in returning home is only climatic. The percentage of improvement and the number of those who could have returned permanently to their homes would have assuredly been very much greater had several more exercised forbearance in delaying their return until the disease was more decidedly arrested. I am firmly of the belief that cases cured in elevated countries have at least as good a chance of keeping well after returning home as those cured at sea-level, and, owing to the decided increase of general and pulmonary vitality imparted by the climate, probably a much better one." These opinions coincide with those expressed by the other observers of altitude treatment.

General Conclusions.—The reports, which are all that could be gathered, are from sixteen different sources, reported on by the best-known observers in Europe and America, based on a total of nearly five thousand cases. The climates in which the cases were treated were various and widely scattered, so that the influence of every kind of climate is here represented. The deficiencies in some of the reports undoubtedly prevent a fair comparison at certain points, and in the reports where the number of cases is few the results are naturally sometimes too high or too low. The care or opportunities in following up the cases of course varied much with the different observers, as well as their degree of conservatism in making statements and their views as to the exact meaning of the terms "cured" and "improved." Therefore a close comparison between each of the several sets of observations cannot be made. When, however, we group them together, the law of averages comes in and the optimism of some observers is balanced by the conservatism of others.

The general truth of the reported results, however, is shown by the close resemblance of the figures in the different groups. Especially is this the case in the three chief divisions made—namely, of reports of cases treated, first in open resorts in low climates; second, in sanita-

riums in low climates; third, in low climates, both in open and closed resorts (sanitariums) combined; and fourth, in open resorts. Again, the differences in the quality of the cases prevents close comparison between them.

Gross Results.—In contrasting those treated in open and closed resorts in low climates, we find that twice as many were cured in closed as in open resorts in all stages, while in the first stage there were probably more even than this, but the figures under this head for open resorts are too scanty to make a fair comparison, while the total benefited is about the same, being even higher at all stages in open resorts. Whether this is due to a different use of the somewhat elastic term "improved" or some other accidental cause I do not know, but it seems somewhat out of harmony with the general tendency of the figures. Taking the results from all treated in low climates compared with all treated in high climates, we find that three and a half as many were cured in high climates as in low in all stages, and in the first alone three times as many, while both in all stages and in the first stage alone only twice the number were benefited. Comparing those treated in low climates in closed resorts with those treated in high climates in open resorts, the difference in cures is not as great, being about twice instead of three times as many.

The final conclusion is, that a consumptive treated in an open resort in an elevated climate has three times as good a chance of recovery as has one treated in an open resort in a low climate, and twice as good a chance as one treated in a sanitarium in a low climate.[1] Though in prescribing a particular resort for a given case of consumption the decision is dependent on many minor points that are elsewhere referred to, yet the broad truth remains that of all factors, climatic or otherwise, in the treatment as well as in the prevention of phthisis, altitude is by far the most powerful of them all.

Indications and Contraindications for Altitude Treatment.

Dr. F. I. Knight of Boston, who has probably made use of altitude in the treatment of phthisis more extensively than any other physician on this continent, and has shown especial care and discretion in the selection of his cases, in the *Transactions* of the American Climatological Association for 1888 published a paper entitled "Indications and Contraindications for Altitude in the Treatment of Pulmonary Tuberculosis," of which I make the following abstract: 1. He limits the

[1] The treatment in sanitariums in high climates is too recent to furnish any reliable statistics as yet, though my observations in the Bellevue at Colorado Springs lead me to believe that the same relative improvement between cases treated in open and closed resorts in low climates that is shown in these tables can be demonstrated in high climates also.

age of those using altitude to fifty years. In temperament he prefers the phlegmatic to the nervous with an irritable heart, frequent pulse, and inability to resist cold; and with the latter, he says, we must not compare those who show nervous irritability from disease, not temperament, as they are generally benefited in high places. As regards disease, he first considers cases of early apical affection with little constitutional disturbance, and although these generally do well under most conditions, yet considerable experience assures him that more recover in high altitudes than elsewhere.

2. "Patients with more advanced disease, showing some consolidation, but no excavation nor any serious disturbance." When both the apices or much of one lung is involved, and the pulse and temperature are both commonly over 100, it is best to begin with a low altitude.

3. Hæmorrhagic cases, early cases with hæmoptysis and without much fever or much disease, are benefited by high altitudes.

4. Patients with advanced disease, those with cavities or severe hectic symptoms, should not be sent to high altitudes. A small quiet cavity is not a contraindication; hectic symptoms are contraindications.

5. Patients in an acute condition should not be sent.

6. Cases of fibroid phthisis are not suitable.

7. Convalescents from pneumonia or pleurisy are usually well suited to elevated regions.

8. Advanced cases of tubercular laryngitis, if good local treatment and freedom from dust can be had, may do no worse than elsewhere.

9. In cases complicated by other diseases there is much care needed. Cardiac dilatation precludes high altitudes; so also does hypertrophy for the most part, though with exceptions. A cardiac murmur the result of endocarditis quite long ago, with no signs of enlargement or deranged circulation, should not prevent. Nervous derangements of the heart are usually contraindications. In renal disease and in chronic hepatitis the local physicians claim that benefit is often obtained. Intestinal ulceration is not barred out, but benefit is doubtful. Heredity to phthisis is no bar to high altitudes, but diabetes render them objectionable. Syphilis is no contraindication, though in phthisis the combination always makes the prognosis bad.

I will here finish this branch of our subject with an extract from a paper I read before the American Climatological Association, September, 1889, entitled, "Invalids Suited for Colorado Springs:" "The most marked benefit is shown in antagonizing and arresting tuberculosis in those whose ancestry or physique, or both, convey the impression of their being affected with a tendency to a general tuberculosis. Hæmorrhagic cases are found to do well. Phthisis consequent upon croupous pneumonia or pleurisy is generally benefited. The presence of a

cavity is not, in itself, a bar to receiving benefit. Fibroid phthisis is usually improved. Cases of so-called catarrhal pneumonia generally do well, but if there is a marked tendency to acute febrile catarrh of the tubes or a specially irritable and useless cough, a more medium climate is indicated. Rapid progress and pyrexia are not contraindications if there is evidence of a sufficiency of healthy lung remaining, and if the patient is able to take and assimilate enough food, and shows a fair power of reacting to stimulation by cold and a capacity toward recuperation from fatigue. Very moderate dilatation of the heart in the young is not a positive contraindication if care is exercised, nor is old valvular disease if tolerated and compensated for. Albuminuria caused by lardaceous disease would be a decided contraindication. Any renal complication of phthisis makes the experiment of change to Colorado of extremely doubtful advantage, though chronic Bright's disease, without pulmonary disease, is usually favorably influenced. Chronic catarrh and inflammation of the throat, nose, or bronchi are generally improved, and even tubercular laryngitis is, *per se*, not a contraindication.

"To sum up as regards the individual, the anæmic and phlegmatic are best influenced; as regards the disease, the chronic, the first as regards the stage of the disease. A larger margin of sound tissue in the peccant organ is demanded than in changing to a less extreme climate, and a certain evidence of vital resiliency is imperative. With respect to pulmonary disease, let it be especially remembered that in sending your patients to Colorado you are putting them, as it were, in a gymnasium, and they will need prudence and instruction to benefit by it; that the whole principle of the influence of altitude upon chronic disease is the exciting of a healthy life in the place of an unhealthy, and that in the process there comes the strain of the battle; that in prescribing an altitude, to ensure success, as in prescribing the most powerful remedies of the Pharmacopœia, the method of administration demands our most careful consideration."

Cases of Phthisis Suited for Altitude Treatment.—The next best climate for most of these is undoubtedly a low, dry one: when, however, there is much irritability of the nervous system, the heart, or mucous membranes, a warm, not hot, climate, with medium dampness, is desirable for its sedative effect and through allowing much outdoor life. There are also climates where a partial effect of altitude is obtained at elevations between 2000 and 3000 feet. Dr. G. A. Evans, in his excellent *Handbook of Phthisiology*,[1] gives the following classification of the climates resorted to by consumptives in the United States, which may be found of service in making a choice

[1] *Handbook of Phthisiology*, G. A. Evans, D. Appleton & Co., New York.

for a particular case, provided the governing principles have been previously grasped:

1. *Climate Cool and Moderately Moist.*—General elevation 2000 feet, western slope of the Appalachian chain, Adirondack, Catskill, Alleghany, and Cumberland mountains. 2. *Climate Moderately Warm and Moderately Moist.*—Between North Carolina, Asheville, elevation 2250 feet; Western South Carolina, Aiken, Georgia, Marietta, and Thomasville. 3. *Climate Warm and Moist.*—Florida (equable), Southern California, coast region (equable). 4. *Climate Warm and Moderately Dry.*—Elevation about 2000 feet, South-western Texas, Southern California, inland. 5. *Climate Cool and Moderately Dry.*—Elevation about 1000 feet, Minnesota, Nebraska, Dakota. 8. *Climate Cool and Dry.*—Elevation from 4000 to 7000 feet, Montana, Wyoming, Colorado, Northern New Mexico, and Western Kansas. 7. *Climate Warm and Dry.*—Elevation 3000 to 5000 feet, Southern New Mexico and Southern Arizona.

Affections of the Respiratory Tract other than Phthisis.

Convalescence from croupous or catarrhal pneumonia, when the patient is still weak and unable to exercise, is usually best hastened by a warm equable climate, in which time can be passed in lying in the open air; when, however, the clearing up of the affected portion of the lung is delayed, and yet the patient has recovered a sufficient amount of vigor to allow him to walk about and keep his blood in healthy circulation, an elevated climate will generally ensure more complete and rapid recovery, and the cool air, being dry, will prove especially beneficial.

Delayed recovery from pleurisy is generally best treated at an altitude. Convalescence from acute bronchitis is usually completed most satisfactorily in a warm low climate, as also is chronic bronchitis; if the latter proves intractable, it has usually tuberculosis behind it, in which case an altitude should be tried, unless age, emphysema, or heart complications forbid it; then a warm, dry inland climate of moderate elevation is best.

Asthma, when the neurotic element is the prominent symptom, is nearly always relieved most effectually in high elevations, and sometimes cured. When the asthma is evidently dependent upon or overshadowed by cardiac or bronchial complications, medium climates are best, the question of reflex irritation, nasal or otherwise, being first attended to.

Dr. C. Denison in his address as president of the American Climatological Association, September, 1890, reports on 52 cases of asthma treated in Colorado: 72.5 per cent. were more or less improved. All of the cases that got worse, and all but one of the stationary, had

more or less marked emphysema. This agrees with my own observation, that when there is marked emphysema resort to an altitude is useless, and often dangerous.

Chronic Laryngitis.—When tubercular, I am firmly convinced that treatment in an elevated climate is more apt to mitigate, and occasionally to cure, this usually hopeless disease than when administered in a low climate. My statistics, published in the *Transactions* of the American Climatological Association for 1890, show this. In chronic laryngitis, non-tuberculous, the climate must be fitted to the case upon general principles, and such questions asked, Does the disease improve most under sedative or stimulating treatment? Is the patient better in damp or dry weather? etc. The same rule applies to catarrh and chronic inflammation of the pharyngeal and nasal tracts.

Diseases of the Heart and Great Vessels.

As this subject has been mentioned before in connection with sea climates, I will here refer only to the influences of elevated climates, and thus, by placing before the reader the effects of the two extremes of climatic change, give the guiding principles for selecting a climate for a particular case.

It is a matter of universal observation in Colorado that the heart-beats are at first increased, and that in those with whom the climate agrees, and in whom there is no pathological condition preventing it, the heart-beat will return in time to its usual rate, the time being longer or shorter according to the general vigor and age of the individual. That one of the secondary effects is to make each cardiac contraction stronger is, I believe, true. The direct impression gained from observations by ear and finger on the relative strength of the contractions agrees with this. Pathological observation, however, is the best evidence. A considerable number of anæmic consumptives, especially when young, have a tendency, more or less developed, toward simple dilatation. Many cases which gives no signs at sea-level exhibit them on first coming to Colorado. Such cases, if permitted to exercise only with great care, generally gradually lose all symptoms of dilatation, and some in time show signs of hypertrophic compensation, if improvement in general health occurs, and if, of course, the cardiac muscle has not been stretched too far or is not degenerated, so as to prevent it from regaining its elasticity. The observations of Oertel confirm this view. Moderate dilatation in persons under thirty years, who otherwise the climate benefits, is often improved if they will submit to very strict medical discipline, especially in the matter of exercise; but practically such cases can usually be treated successfully in other places with much less risk than they encounter at this elevation. Graduated gymnastic exercises and climbing steps and moderate hills

can, I believe, be better used to strengthen the cardiac muscle than putting them under the continuous strain that living at an altitude of 6000 feet involves. Where the dilatation is marked the exercise at this elevation is necessarily so limited that the patient is apt to chafe under the restriction and break it to his own detriment, or suffer in general health for want of sufficient exercise to promote appetite and nutrition.

It is hardly necessary to say that all cases in which there is fatty degeneration of the heart, or in which there is evidence of grave valvular lesion without ample compensation, should not be exposed to the dangerous strain that the first effects of the climate involve. Cases are seen in Colorado who have passed through this period, and who, living a careful life, do comparatively well. No doubt in such cases it is because the secondary and chronic climatic effect is to equalize the blood-pressure throughout the entire vascular system and make the circulation vigorous and complete. All the finest capillaries being well filled, the continued effect is to relieve strain in all parts and to get rid of chronic local congestions. The most powerful proof that the foregoing statements are true is the fact that has been established by Archibald Smith, from his experience in the Andes, of a marked mitigation of the symptoms in cases of aortic aneurism; and this the observations of myself and my colleagues fully confirm. Nevertheless, in view of the great danger of permanent increase, during the early portion of the stay, or by sudden or violent exercise during any later period, it cannot be wise for the physicians to recommend such cases to come to this elevation. Were the American patient, like the German, more dependent upon the judgment of his physician, this advice would doubtless admit of modification; but, alas for the procuring of the best results of treatment, our patients have yet to learn that in many diseases the autocratic regulation of their daily exercise is the most valuable aid that medical skill can offer them. The decided effects of the altitude in exciting and disturbing the action of the heart in sensitive persons, even without disease, is shown by many who, after living comfortably for several years at this elevation, 6000 feet, ascend to the summit of Pike's Peak, 8000 feet higher. These persons, while there, except for a feeling of lightheadedness, are all right as long as they do not attempt to walk, when even a few steps taken will bring on rapid and often irregular beating of the heart, generally slight headaches, and often nausea and diarrhœa, and, in some, slight præcordial pain, the headache and pain over the heart often persisting more or less for twenty-four hours after their descent. Cases of valvular lesions in which there are no secondary complications, and there are exhibited accommodation and tolerance both local and constitutional to the impaired working of the organ

while the patient is prudent, are decidedly benefited by the tonic effects of altitude.

With respect to nervous affections of the heart the question of climatic influence must be approached from the nervous and not the cardiac side of the subject. Cases of anæmia and chlorosis are invariably relieved by the Colorado climate.

In choosing the climate for a patient with cardiac disease, apart from the question of atmospheric pressure here referred to, the promotion of the general health, and especially of encouraging the activity of the skin and kidneys, has to be considered, with a view of relieving the strain upon the circulation.

Diseases of the Nervous System.

Where organic lesions are progressing a sedative climate, such as a warm, sheltered sea-shore, is certainly the best. In chronic organic disease of long standing, with fair general health, a dry cold climate or a high elevated one may be cautiously tried when other climatic change has been unsuccessful; but age, atheroma, or cardiac complication would be decided contraindications. In cases of functional disease the turning toward sea or mountain is influenced by the question of whether a sedative or stimulant is called for. The former is the more suitable where there is much nervous irritability with a good circulation, and the latter when it is accompanied with a feeble pulse and cold extremities. The same also holds good when there is nervous depression, mental or general. With respect to the influence of altitude upon nervous diseases, Dr. F. T. Eskridge of Denver read a valuable paper before the Climatological Association, September, 1890, and I reported on cases treated in Colorado to the Colorado State Medical Society, 1879; both of which support the foregoing conclusions.

Neurasthenia.—One of the most serious symptoms of this disorder is usually insomnia, and the climate which best relieves this is the one in which the greatest general benefit will be found. As showing the effect of altitude upon neurasthenia, I will quote five cases treated in Colorado which I reported some years ago. The conclusions drawn from them have been confirmed by more recent clinical experience.[1]

In judging of the effect of the climate it is necessary to separate the improvement that is specially due to the particular locality from that which is due to the influences common to any place where the patient enjoys fresh air, sunshine, and relaxation from strain and worry. This separation can only be effected satisfactorily when the patient has tried other climates for the same symptoms. In five cases

[1] "Influence of the Climate of Colorado upon the Nervous System," by S. E. Solly, *Colorado State Medical Society Transactions*, 1879.

of which I have notes the patients had tried other climates. The outlines of these I will briefly give:

Case 1. D. B——, aged thirty-four years, secretary to a railroad company, enjoyed good health up to 1870, when he began to be much worried and overworked; went to Europe in consequence of breaking down with the following symptoms: Insomnia; forehead-ache; irritability of temper, with depression of spirits; inability to fix his attention on writing or reading for more than a few minutes at a time; rheumatic pain in the calves of both legs, increased by walking; frequent perspiration, then "pins and needles" in legs; later, tingling in arms, then forearms and hands, preceded by what he called a "nervous grip," beginning in the neck and passing around to the jaws; at the same time some want of control over the bowels, not over bladder; cardiac palpitation; digestion easily upset; some tremor and no vertigo. He travelled in Europe for a year, then returned home with all the symptoms abated and in good general health, but not entirely recovered, as proved by inability to do much work for some time; then got into fair health, worked hard, and in March, 1876, same symptoms began to come back, and in October, 1876, he came to Colorado Springs, at that time much worse than in the first attack. Did not see much change on first coming, except that he slept better. Came under my care on October 27th. He was treated with tonics, a diet for trouble of bowels, moderate exercise, and bromide of potassium when required. He had some nervous attacks, brought on by unusual exercise or excitement, when he felt worse than he did when at home or in Europe; they quickly passed off, and in the main his improvement was steady, until, at the end of January, 1877, all his symptoms had disappeared, and he was able to apply himself for several hours to reading or writing without feeling any bad effects. By my advice he then left Colorado for a trip through the South with friends. He continued to gain strength, and resumed his official duties in the following May, and was married in the fall. I have heard from him recently as being perfectly well and equal to any ordinary work. In this case a residence of four months in Colorado did more for him than a year's trip in Europe.

Case 2. H. H——, lawyer; aged forty-eight years; had previously enjoyed good health, and had worked hard for twenty years at his profession. In 1870 he broke down, with violent headaches, especially at the back of head and neck, insomnia, slight vertigo, nervousness, inability to concentrate his mind, and there was present phosphatic urine. He now took a sea-voyage, and travelled in China and elsewhere for more than a year. He partly recovered, though he was not so strong as before; and he did not improve at all till the last few months of his holiday. The same symptoms returned in May, 1877, and continued

to increase until he was obliged to give up work and come to Colorado for a rest, which he did on July 16, 1877. He said he was not quite as bad as when he went away eight years before, but he felt he would soon be so if he continued working. Except for sleeping better, he did not feel any relief till he had been in Colorado about a week, when he began to pick up. He remained at Manitou a short time, when, excepting for regulating his bowels, no treatment was carried out; he then made a fishing and shooting excursion of two months' duration through the mountains, at the end of which his symptoms had vanished, and he said he felt equal to work again, and returned home to resume work in a modified form. In this case the symptoms were not so advanced as when he took his sea-voyage, yet the effect of the change of air was much more striking and rapid in Colorado.

Case 3. F. G——, aged forty-two; engaged in an extensive business; has worked hard all his life in his office; always dyspeptic; dyspepsia became worse in December, 1876, and to it were added certain nervous symptoms—headache, insomnia, and nervousness, differing from those arising previously from dyspepsia. He arrived at Manitou August 10, 1877, and continued the same treatment as before for the dyspepsia. He lived most of the time out of doors, and returned home in five weeks with nervous symptoms entirely removed and dyspepsia much improved. He wrote me last month from Pau, in the south of France, that, his trouble having returned during the winter, he had gone to Europe, and, though improved, did not find that he recovered as quickly as before, and believed Colorado was the best climate for him. In this case the dyspepsia was evidently dependent upon the nervous exhaustion.

Case 4. H——, aged forty-nine, merchant; had been tied down to his business for many years; had twice before been attacked with dull pain in back of head and neck, insomnia, languor, and nervousness. He had each time gone to Europe and returned well. He came to Colorado in April, 1878, with the same symptoms as before; and remained only three weeks, but his symptoms left him after he had been here a week.

Case 5. R. S——, aged forty-five, manufacturer; had always worked hard at his business; three years before had an attack of pain across forehead, with vertigo, and sore feeling in back of neck, some difficulty of vision, inability to concentrate thought, and insomnia. He went to the Atlantic seaboard for two months and the symptoms disappeared. After this he came to Colorado, October, 1877, with the same symptoms, and after a few days began to improve, and left in a month free from any trouble.

In these cases there was evidently no material change of structure or important complications.

Admitting the difficulty of comparing accurately the condition of these five cases during their early and later attacks, the last of which brought them to Colorado, they at least show that the fatigued brain and cord were not irritated, but soothed and rested in the pure mountain-air.

I regret that I cannot command for comparison any clinical reports of cases treated in ocean climates. I am, however, very strongly of the opinion, allowing the contraindications which have been suggested, that the larger proportion of cases of neurasthenia are most surely and quickly benefited by high climates. This opinion is formed from my observations in Colorado, and also in noticing the effect upon such patients who were sent from England to Alpine resorts. Where, however, there is but slight if any anæmia and much irritability, the sea-shore, or still better a sea-voyage, is more suitable. In choosing a climate for cases of chronic neuralgia or migraine the same general principles must guide us.

Epilepsy when not improved at the sea-shore is often benefited at an altitude, but it is always safer to try the more sedative climate first, and mere change will often make remedies of more avail in those cases which admit of improvement. Chorea is generally best treated in low climates.

Kidney Diseases.

Parkes demonstrates[1] that as the temperature of the air rises above 49 degrees the urea, chlorides, and other constituents of the urine decrease. In the Royal Society's *Transactions* for 1861 it is observed that the urea is lessened with severe cold, and Dr. Edward Smith's observations, made in England during an exceptionally cold year, proved that more urea is secreted in summer than in winter.

The British Government statistics and the observations of Dickinson, Morehead, Martin, Hyaltelin, and Chambers prove that renal disease is most common in temperate climates, and least so in cold ones, and, if the secondary or lardaceous cases are eliminated, rare in the tropics. The prevalence of the disorder in temperate climates may be explained, as Dickinson suggests, by the axiom that the liability of an organ to disease, particularly to inflammatory disease, bears a general proportion to its functional activity. The respiratory organs are more active in cold, the kidneys in temperate, the liver and bowels in hot, climates.

The statistics of the British army, taken for upward of eight years in all parts and all climates of the globe, confirm this by demonstrating that the prevalent diseases in Arctic climates are catarrhal affections of the respiratory tract; in temperate climates, tubercular and renal disorders; and within the tropics, dysentery, hepatitis, and malarial

[1] Parkes on *Urine*, p. 95.

fevers. Statistics show that a wide range of temperature with sudden changes increases renal disease; where the range is high, however, these variations do not increase the amount of the disease, but where it is low, it does so to a marked degree. Statistics also tend to exhibit the fact that dampness develops the disease, but as this element is so mixed with other factors, this point is not thoroughly demonstrated. It is, however, a matter of common observation, writes Dickinson,[1] that patients with albuminuria thrive better and prefer a dry bracing air to a damp relaxing one.

Dickinson further states that statistics prove that renal diseases chiefly abound where the mean annual temperature is not so far removed from fifty degrees, while in whatever direction we leave the temperate range we find albuminuria less common. In Iceland it is rare, and, going toward the warmer latitudes, excepting the lardaceous form, it diminishes as the temperature increases. He indicates further that with an equivalent temperature the dryer climate shows less kidney disease. Copland[2] enlarges upon the fact that the skin of the negro is a much greater and more elaborate apparatus for excretion than that of the natives of temperate and cold countries. In the white man, inhabiting the hot countries, he shows that the liver is larger and more active to supplement the comparatively deficient cutaneous action, while in temperate climates the kidneys more especially aid, and in cold climates the lungs still more.

All the observations referred to, however, dwell much upon the temperature and very little on the humidity, and this neglect of the consideration of humidity and temperature together is common to all but recent writers. Weber says: "The separation of water by the lungs and skin is diminished in great dampness and more work devolves upon the kidneys, while their activity is less called upon when the air is dry and warm; and we must always pay great attention to this in affections of the kidneys." He further writes: "As cold air contains less vapor than warm, therefore there is more loss of water by the lungs when the air is cold than warm." It is admitted that warm dry air relieves the kidneys by increasing the amount of water excreted by the skin, while the warmth, as opposed to the cold, rather decreases the excretion of water by the lungs. Why should not cold dry air also relieve the kidneys through the greater excretion of water by the lungs, compensating equally for the lessened excretion by the skin, and (as it has been shown that in the white races the lungs take more of the work of excretion upon themselves relatively than does the skin, and that in the body's economy the compensating power of an organ is

[1] *A Treatise on Albuminuria*, by W. H. Dickinson, M. D., W. Wood & Co., New York.

[2] "Climate," *Copland's Medical Dictionary*, Longmans, Brown & Green, London.

exerted, within reasonable limits, in proportion to its needs) it is rational to suppose that the increased activity of the lungs compensates exactly for the skin's deficiency, and that cold dry air relieves the kidneys as much as does warm dry air.

It must be admitted that theoretically a warm dry, equable climate is the ideal one to relieve the diseased kidneys at their work. But this is, as has been shown elsewhere, a combination of qualities which cannot exist in nature, for the reason that the dryer the climate the less the equability; with dryness comes relief to the kidneys by more evaporation from both lungs and skin; with dampness, on the other hand, less evaporation, but also less danger from changes of temperature; with warmth, more secretion from the skin and less from the lungs; and with cold, more from the lungs and less from the skin; with warmth, again, more prolonged outdoor life, and with cold more toning up of the general vitality. Thus whatever way we look we find that in one or other of the elements there is a falling short of the ideal standard of climate.

To pass from the theoretical to the practical consideration of the subject, beyond such opinions as I have quoted very little clinical evidence is furnished by the barren literature of this subject, and certainly nothing has been proven.

The Influence of Climate upon Bright's Disease.—As observations of the effect upon this disease of such an extreme climate as Colorado may tend to shed some light upon the probable influence of climates in which the conditions are more or less reversed, I will quote from a paper I wrote some seven years since:[1]

"During a general practice of nine years in Colorado Springs and Manitou, leaving out cases of lardaceous disease, I believe I have seen a smaller proportion of cases of Bright's disease than would be expected in most other localities.

"I remember but four cases of primary renal disease that I have treated, all of which came from the mountains. They arose from a great and sudden exposure. They were all relieved on being brought to this lower level, and, though seriously ill, all made good recoveries whilst here. It is usually believed that acute nephritis is not infrequent among miners and ranchmen in the mountains. Inquiries I made recently at Leadville from four physicians who had been in large practice there for several years by no means confirmed this opinion.

"Although I have examined the urine at some period during pregnancy in the majority of cases that have come under my care, I remember to have found albuminuria in a very few, and only in two were any further symptoms developed: one with slight œdema became

[1] "Bright's Disease of the Kidneys, as Influenced by the Climate of Colorado," by S. E. Solly, *Transactions Colorado State Medical Society*, 1884.

perfectly well after confinement; the second, with convulsions and abortion at seven months, had a mere trace of albumin and no casts, and no other symptoms two months after the miscarriage, when she left for the East.

"I have frequently examined the urine during convalescence from scarlatina, but only remember one case of Bright's disease in consequence of the fever. In this instance there had been exposure and neglect, and there was much dropsy. The case, however, made a good recovery, remaining in this climate. In practice in London previously I found albuminuria a common sequela of scarlatina. In our county society the opinion of my colleagues was that scarlatinal nephritis is decidedly rare in this district.

"Lardaceous disease of the kidney being systemic in origin, makes it impossible to separate the climatic influence upon the kidney from the antecedent disease, and therefore we will omit such cases as not being pertinent to our inquiry. As regards other cases of chronic Bright's disease, I do not call to mind any whose origin could be stated positively as occurring in Colorado. The only cases that seem to me that can be brought forward to illustrate the effect of the Colorado climate upon the progress of the disease are those where time has been spent during the recognized course of the malady both in this and another different climate. Of such cases I have notes of only four, nor do I remember any others showing contrary conclusions. I will therefore briefly report these four cases:

"CASE 1. *Chronic Parenchymatous Nephritis.*—This patient first became aware of his disease two years ago, while on the Atlantic coast, through consulting a physican concerning a considerable swelling of the abdomen and feet. He continued to get worse for three weeks, when he came to Colorado, when I found he had ascites and general œdema, granular casts and blood in the urine, with 2 per cent. of albumin. He was treated with jaborandi, Turkish baths, Basham's mixture, and a milk diet, resulting in the removal of the dropsy and a general improvement. He remained in Colorado for a year, during which time he attended to his business, and several times walked as much as twelve miles hunting, and, except after an occasional cold or overwork, the albumin steadily diminished, so that on reaching the East it was found to be only one-twelfth of the bulk. He remained East three months, during which time he caught several colds. His general health while there was fair, though he did not feel vigorous. At the end of three months he returned to Colorado, when I found the albumin had increased to one-fourth the bulk. He remained in Colorado about nine months, and worked harder than ever at his business. During the fall, after getting wet wading for ducks, he had a considerable further increase of albumin, which afterward dropped

again, and on leaving for the East in the spring the albumin was again only one-twelfth of the bulk, with an occasional hyaline cast. Five pints of urine were passed in twenty-four hours. There was no œdema, and, except for being tired from business worry, his general health was better than it had been since the beginning of his illness. During this time he had kept to a milk and vegetable diet, with occasional relaxations, and had taken Basham's mixture most of the time. The weight increased a few pounds.

"CASE 2. *Chronic Interstitial Nephritis.*—This patient had chronic catarrhal pneumonia, resulting in consolidation of the upper half of the upper lobe of the left lung. The disease was arrested before coming, and was non-progressive whilst here. The renal disease had been discovered about a year and a half previously, and was apparently the result of diphtheria. He reached Colorado in September, and remained until the following May. On arrival the albumin was one-fifteenth of the bulk of the urine, and no hyaline casts were found; amount of urine a little below normal. It was a more than usually windy winter, and it was the gentleman's custom to drive some three miles to a camp he had in the woods, and remain there until about three o'clock in the afternoon, eating his lunch and sitting in the open air or, when too cold, in a little cabin. The mornings were generally warm and still, but most afternoons he had to drive home through a cold wind. He had two slight attacks of pleurisy, but otherwise gained slowly, and on leaving was decidedly in better health. The urine was normal in amount—no casts, the albumin loss being one-twenty-fifth of the bulk. After his return he continued to live East, and died a year later from renal and other hæmorrhages after sudden exertion. The treatment in Colorado was merely general care.

"CASE 3 was one of chronic parenchymatous nephritis, detected about six months previous to arrival while in the East, where he lived. There was no œdema or general debility. The record of the urine is lost, but there was a moderate amount of albumin with granular casts, and on leaving, after spending the winter, the percentage of albumin was decidedly less—very few casts, and little less than the normal amount of urine passed. He was on a milk diet. He returned East in more vigorous health, but the subsequent history I do not know.

"CASE 4. Chronic parenchymatous nephritis, probably consequent on nervous shock from severe fall and injuries whilst living in the East, a year previous to coming to Colorado. This case was under observation, off and on, for three years, during which time he was chiefly in Colorado, especially during the first year and a half, but went across to Europe, and remained East during portions of the three years. When first seen there was 1½ per cent. of albumin, numerous granular and fatty casts, slight ascites, considerable œdema of lower

limbs, and much pain over kidneys. The treatment was a mixed diet, tincture of chloride of iron, alkaline waters, and dry cuppings. At the end of three years there was no trace of albumin or casts. The amount of urine passed was about normal, and the general health good. The patient continues well and lives East.

"Each of these four patients, in contrasting their experience of the climate of Colorado and that of the East, said that they found that they less often caught cold here than elsewhere, and that when they did so they got over a cold more quickly.

Healthy Kidneys.—"With regard to the effect of climate upon healthy kidneys, persons during the first few days after their arrival have frequently called my attention to the 'thickness' of their urine, which upon examination proved to contain an excess of solids, especially the urates. These persons have usually thought also that they passed perhaps less water, but certainly more frequently. This condition usually passed off in a few days, and the urine returned to its normal appearance. This would suggest that the excretion of water by the lungs and skin was much increased at the expense of the kidneys, at least on first coming; and this the parched skin would bear out.

"My friend, Dr. S. A. Fisk, informs me that from quantitative and qualitative analyses made by him upon specimens of urine taken from healthy persons who were permanent residents, the urine was normal, except perhaps the specific gravity being slightly higher. This would indicate that in healthy persons the balance between the excreting organs is in time regained.

"The points that seem to me suggested at this stage of the inquiry, though as yet nothing is established, are the following:

"First. Acute nephritis, like all acute inflammations, is not infrequent in Colorado, especially in the mountains, where the inhabitants, not being natives, are careless of climatic extremes, and that when occurring is, like all inflammations at an altitude, more than usually acute; that acute nephritis is not especially induced by the climate, but, having risen, is in its outset aggravated by it.

"Second. The direct tendency of the climate in chronic nephritis, as in most chronic diseases, is toward its cure. This beneficial influence is mainly exerted through the increased action of the lungs, and to a less extent of the skin, affording relief from work by the kidneys, and by the general stimulating and equalizing of the circulation, lessening the renal congestion."

My observations during the past five years following the time of this report tend to confirm these conclusions. Cases 1 and 4 are still alive and well: the former lives East, and was seen by me a few months since, and the latter has returned here and does business. A case of chronic interstitial nephritis consequent upon typhoid fever came to

Colorado four years ago in poor general health, and with a few casts and a little albumin in the urine; she improved very much in her general condition, the analysis of urine remaining relatively about the same and the amount not further diminishing. She died, however, a few months since from pneumonia following a second attack of typhoid fever. This case shows that the progress of the disease, while it may not have been retarded, was not accelerated by residence at an altitude.

Sir Andrew Clark stated to me that he found that kidney affections were frequently developed among the consumptives residing in the High Alps. I do not know what was the exact nature of their disease, and I have been unable to ascertain what is the average percentage of cases of lardaceous kidney among consumptives generally. In 150 cases of phthisis which I treated in Colorado and traced up there were 4 with this complication—2 who were affected before coming to Colorado, and 2 since. In all of the patients the urine was frequently tested. It is quite common in Colorado to find in fatal cases at the last more or less œdema, but the test-tube and microscope often fail to show any renal affection; doubtless the œdema is due to the weakening heart. I believe that the somewhat prevalent opinion of the frequency of lardaceous kidney in Colorado is due to this œdema being present and no test being made. With respect to nephritis, acute or chronic, among the 150 consumptives referred to there were 3 cases. Two began in Colorado—one acutely, the other slowly. The former, who showed unmistakable evidence of a tuberculous kidney, is still in Colorado and much improved, though he has a little albumin and a few casts. The latter case died of his pulmonary disease with increase of the renal symptoms.

In the present state of our knowledge it is undoubtedly safest to try a warm climate first, which may have a high humidity, but must have a moderate rainfall. The age of the patient should much influence the choice between a warm and a cool climate, and also the stage of the disease; and whether it is reasonable to look for cure or only alleviation of the malady is a most important point.

Diabetes, both mellitus and insipidus, would appear not to be diseases *per se*, but symptoms resulting from disturbance of the functions, or change in the structure of, some portion of the nervous system or of one or more of the digestive organs, notably the liver. Change of climate, though not usually of the first importance in the treatment of this disease, is often an aid to other therapeutic measures. The choice must then be determined by the primary causes of the affection, as, for instance, when the cause appears to be too high living in a full-blooded person, a low unstimulating climate at a spa, such as Carlsbad, where the waters are rich in the salts provocative of increased metabolism, is indicated. When, again, digestive or excretory causes are at the root

of the matter, and the patient is of the anæmic type, the mountains are of the most avail. Where the nervous system seems most to blame, and when an actual lesion is suspected, a warm sea-shore is generally indicated, while in cases in which the nervous symptoms are functional and more or less anæmia is present, elevated climates will probably do more to retard or cure. I have watched with interest the progress of several cases of diabetes while they resided in Colorado, but have been unable so far to come to any conclusions on the influence of altitude upon the disease.

Hepatic Affections.

Where there is evidence of a serious organic lesion the only change of climate admissible would be a comparatively negative one. In functional disturbance, on the other hand, climatic change of a positive character, as from sea to mountain or *vice versâ*, is often of the greatest benefit. The direct influence of climate is perhaps more marked upon the functions of the liver than on any other organ. Speaking broadly, persons may be divided into those who are made bilious by going to the sea-shore, and those upon whom the mountains have a similar influence. It will be found, as a rule, that with fair and full-blooded persons the liver acts best on the sea-shore, while with the dark-skinned and anæmic in mountain-air the hepatic functions are the most regular. The question is, Do the nervous or circulatory systems call for a sedative or stimulating tonic quality in the air to provoke or regulate the necessary metabolism and thus bring back health? Dr. Weber and other writers on climatology have spoken of the favorable influence of elevated climates upon sluggish circulation in the abdomen generally, and so it has appeared to me that passive congestions in anæmic persons were usually benefited at an altitude, while it failed to agree with the full-blooded or those in whom there were active congestions or marked nervous irritability.

Attacks of Gall-Stone.—To remove the conditions upon which the formation of gall-stones is dependent certain drugs are generally called for, notably sulphate or phosphate of sodium, and clinical experience indicates that these are of most avail when administered in a natural mineral water. A suitable spa should therefore be sought, but to get the best effects one should be selected in a climate that is best suited to the patient upon the general principles already laid down. The success or failure of treatment at Carlsbad is undoubtedly mainly due to these general principles. As balneotherapy does not lie in the range of this article, I cannot well pursue the subject further, but I may mention that I have been much gratified by the prompt results in the treatment of gall-stones by the use of the Shoshone Spring at

Manitou, Colorado.[1] Some of the cases had previously been treated at Carlsbad with very imperfect results. The Manitou spring is very much less rich in the requisite salts, and often requires an artificial addition; I cannot therefore but believe that the climate as well as the spring is often not sufficiently considered.

Affections of the Stomach and Bowels.

Very little can be said about the influence of climate upon such disorders, except to follow the general principles laid down concerning other diseases, and to fit the climate to the individual rather than to the disease. Temperature has, as has been elsewhere pointed out, the most marked influence upon the secretion from the intestines. As a generality, it is true that a hot climate provokes diarrhœa and a cold one constipation; while as regards the effect of humidity, though it tends to increase the amount of diarrhœal affections, yet where heat is present in spite of the absence of humidity not a little diarrhœa and dysentery is found, though seldom of as grave a character as in warm damp climates. The cause is probably in the marked change between day and night, sunshine and shadow. Cases of chronic diarrhœa and dysentery and chronic dyspepsia, as well as chronic ulcers of the stomach and duodenum, which have arisen while the patients were residing in low climates, and which the best therapeutic measures at home have failed to cure, will frequently recover under similar treatment if they remove to an altitude; and, on the other hand, I have known cases arising in Colorado, which have become chronic, that were quickly benefited by a change to the sea-shore.

Conclusion.—We have now travelled over the main routes which open up the field of climatotherapy, and have endeavored to exhibit the general principles, though not the details, of the subject. The scientific study of climatic therapeutics may be said to be in its infancy, and although the literature of the subject is abundant and is enriched by valuable works, such as those of Weber, Lombard, Hirsch, and others, yet the grains of wheat among the chaff are comparatively few and widely scattered. Most writers in describing the effects of a particular climate write empirically, but without having first studied the known facts and general principles of climatology, and do not connect their fragmentary studies with the general subject, and do not even give logical reasons for their statements where other proof cannot be obtained. Verbose or poetical descriptions of scenery or glittering generalities fill out the most of such articles, and a claim for therapeutic virtue in the particular climate for the most opposite pathological conditions is made, the writers failing to recognize that the more positive the

[1] See *Manitou, its Mineral Water and Climate*, by S. E. Solly, M. D.

climatic effect in one direction, the more positive it is also in the other; in short, that a shield has two sides. When we come to clinical statistics we realize the poverty of the literature and how rich a stream of knowledge is flowing away in thousands of health-resorts all over the world. Of course it is the quality and not the quantity of the records that is wanted, and the careful following up and recording of cases is attended in all chronic diseases with especial difficulty and demands much time and labor. The neglect to record clinical results, especially among those most interested—viz. specialists who send to, and the local physicians who care for, invalids at health-resorts—is very great. This is markedly shown in the comparatively few records of phthisis I have been able to present, only obtaining fifteen sets of statistics. However, there is now awakened a much greater interest than ever before in the whole subject of climatology, and we may look with hope to the future; in the mean time we must speak without dogmatism or extravagance, and learn the lessons that the few facts we have can teach us before we speak at all. In selecting a climate for an invalid let us above all remember to examine not only into the suitable application of the climatic factors to the disease, but also into the peculiarities of the individual and his attendant circumstances.

HYDROTHERAPY AND MINERAL SPRINGS.

By SIMON BARUCH, M. D.

HYDROTHERAPY.

Hydrotherapy is a term derived from *ὕδωρ*, "water," and *θεραπεια*, "treatment," which may be applied to the methodical application of water for remedial purposes, either hygienic or therapeutic. The term has been erroneously applied to the external application and drinking of cold water alone. This is probably due to the popular use of the word *water-cure* adopted by the empirics calling themselves hydropaths, who originally confined their practice to water of low temperature.

Guided by the correct derivation of the term, this article proposes to discuss the therapeutic uses of water in all its forms, from the lowest temperature to the highest, including its application *within* the cavities of the body as well as upon the surface.

Baths for Hygienic Purposes.

Among the agencies which the experience of the human race in all ages has demonstrated as conducing to the preservation of health and the prolongation of life, personal cleanliness takes the most prominent position. Physiology confirms the correctness of this popular idea. The enormous surface of the skin, supplied as it is by all the nervous and vascular accessories which make it a vast gland, causes it to be one of the chief, if not the foremost, depurative organs of the body. Hence its proper discipline becomes a valuable preservative of health, since many diseases are traceable to the influence of temperature-changes upon the skin.

The application of baths for hygienic purposes begins with infancy, when the sensitive condition of the skin demands a careful adaptation of temperature. The daily warm bath, from 90° to 100°, has become a practice among the better educated people for children. Unfortunately, the practice is discontinued too frequently later in life. The advantage of cleanliness as an element of hygiene need not here be dwelt upon. But the value of bathing in lower temperatures for the purpose of maintaining the reactive power of the skin cannot be too emphatically insisted upon, because experience has demonstrated its

effect in protecting the system, commonly termed the "hardening effect." For this purpose a daily rapid contact of the body with water of sufficiently low temperature to produce a shock, which is followed by reaction, is required. That the physician should insist upon not only the frequent systematic cleansing of the body with warm water and soap, which soften the epidermis and remove accumulated secretions, is a trite and oft-repeated idea. But that he should instruct those under his care, especially when young, to accustom the skin to rapid temperature-changes by systematic cold ablutions, followed by exercise, is not regarded as imperative unless some ailment brings the subject to his notice.

The mode of life of the present generation, which differs from that of more primitive times by intensifying the nervous energies and enhancing the desire for stimulating food, drink, and occupation, which conduce to a diminution rather than an increase of physical vigor, demands the introduction and popularization of some method of counteracting these influences. Weak constitutions, manifested by anæmia and muscular inadequacy, have been notoriously improved by climatic influences and outdoor life. If to these were added that methodical daily contraction and subsequent dilatation of the peripheral blood-vessels resulting from a brief cold plunge or sponging, these vessels could be endowed with the same tone and vigor which gymnastic exercise confers upon the voluntary muscles. This is the essence of the "hardening process," as it furnishes the means of improving the functions of the body which depend upon the integrity of the neuro-vascular supply of the skin.

Aside from this effect, this neuro-vascular discipline protects the system, as has been stated above, against those deleterious temperature-influences termed "colds." The exact *modus operandi* of the factors involved in this common process is unknown—whether it be neuropathic, by irritating the terminal sensory nerve-endings, and thus producing reflex vaso-motor and trophic disturbances in the mucous membranes or in the internal viscera, or by chemical changes in the blood, as Senator claims in rheumatism, or, as Winternitz perhaps more correctly surmises, by retention of products of tissue-change. That the thermic impression is most frequently upon the periphery of the body daily experience testifies when we are exposed to a draft of cold air; that it is probably a reflex from the peripheral nerves to the vaso-motor nerves within the body, the rapidity of the effect would confirm. Hence, the education of the peripheral nerves to bear these irritants without resentment would afford protection against them. A diminution of irritability is thus induced by the daily peripheral neuro-vascular exercise caused by cold bathing, which results in "hardening." The most useful method is the gradual accustoming of the body to the shock

from cold water, which is always followed by reaction if the temperature be correctly chosen. To ensure care it has been the author's habit to advise standing in twelve inches of water at 100° F., and resorting to a rapid sponge-bath of 80° F. This is reduced daily two degrees, until a temperature is reached below 50° F. When this has been done a few days, a daily plunge into water at 80° F. is advised, the temperature of which is reduced in the same manner until 50° F. or lower is followed by an agreeable reaction. This is manifested by a pleasant warmth and absence of prolonged coldness of the feet and hands. This bath should be taken in a room having a temperature of not less than 65° F., and ample provision for the rapid execution of the bath and the subsequent drying of the surface should be made. Such a bath has served as a preservative of health and strength in feeble individuals with a tendency to disease, especially in anæmic literary and professional people and in persons who lead a sedentary life or who are subjected to great mental strain in the pursuit of their avocations. Unfortunately, the facilities for such baths are open to but a small portion of the community in cities and towns. But even the humblest dweller in the rural districts may contrive a simple cold sponge-bath if he can be made to understand its value as a preserver of health and a promoter of longevity. The poor in our cities, however, crowded into tenement-houses in which one faucet usually supplies an entire floor, are debarred from this wholesome hygienic measure because of lack of room. Physicians frequently observe how the filthy condition of our poor is responsible for the spread of many diseases. The so-called "tenement-house odor," which so often offends in crowded street-cars or halls, is evidently nothing more than the decomposed sebaceous secretions which have accumulated in unventilated clothing. The modern sanitarian recognizes that in purifying our habitations and our persons lies the great prophylactic.

Public Baths.—Public baths for the poor are becoming more and more clearly recognized in modern times since the first one was established in 1842 in Liverpool. The English Parliament took an active interest in the matter, and encouraged their establishment in the United Kingdom by its wise enactments; and France and Belgium soon followed this example. But Vienna led the world in establishing the ideal baths for the poor in the Volksbad in the Mondscheingasse, which many other German cities have imitated. In his report as chairman of the Committee on Hygiene for 1890 of the New York County Medical Society the writer suggested the erection of similar baths, insisting that the following points be observed:

1st. The baths must be located in the very centre of the crowded districts.

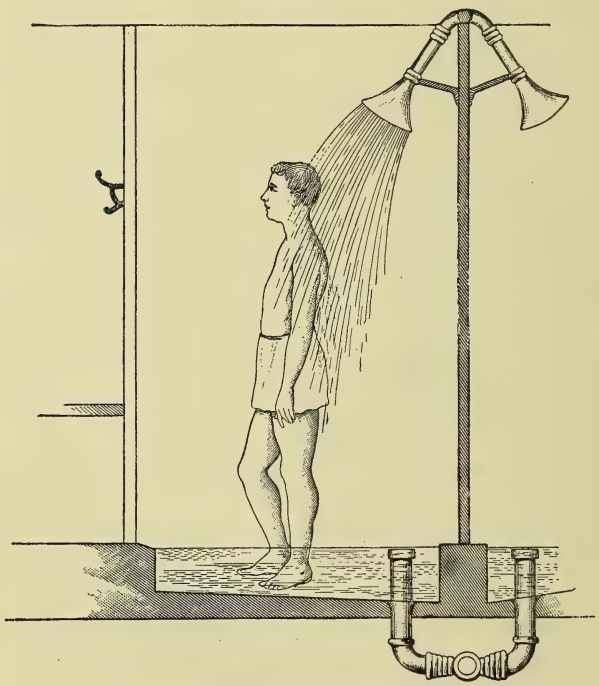
2d. Their exterior must be modest.

3d. They should be so constructed that a thorough cleansing bath may be obtained without trouble or expense and without sacrifice of much time.

These conditions may be fulfilled only by the abolition of the bath-tub and the substitution of the warm rain, or shower-bath for the old-fashioned tub-bath. The advantages of such a bath, falling upon the body with considerable force from a reservoir of some height, are self-evident. By this means—

(1) The outlay for tubs is avoided, as well as the cost of the wear and tear.

Fig. 127.



Compartment for Public Baths.

(2) The avoidance of filling, emptying, and scrubbing of the tub, for each bath economizes labor and expense.

(3) The time needed for a cleansing bath is far less, and the cleansing more thorough, because the patient does not bathe in water already soiled.

(4) The space required is one-half.

(5) The water required is about one-tenth.

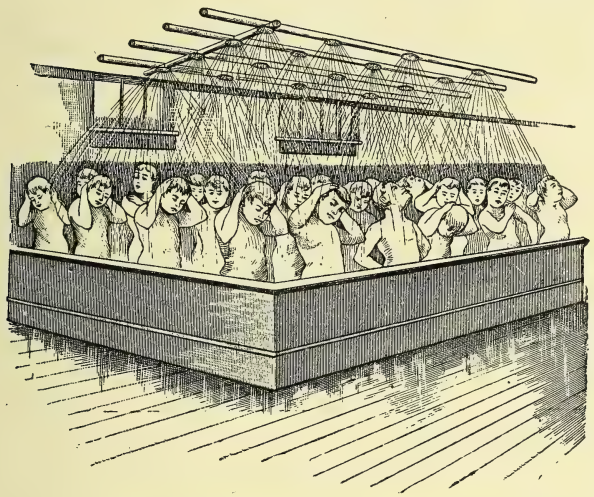
(6) The danger of communicating disease is removed.

(7) The refreshing effect of a cold shower after a warm bath may be secured.

The bather simply steps upon the inclined asphalt floor, opens the valve, and allows the coarse stream of warm water to descend upon him, while he soaps and rubs himself. The soiled water runs off, and the next bather may at once enter.

For public institutions, where large numbers require bathing, the economy and practical value of these rain-baths will be a great boon. I have introduced them into the New York Juvenile Asylum. The arrangement of pipes near the ceiling is provided with sixty-eight convex sprinklers, $2\frac{1}{2}$ inches in diameter, 20 inches apart, throwing a stream which widens to fifteen inches, and is placed over the tiled slanting floor of the bath-room. By mixture with steam the water is heated

Fig. 128.



Author's Bath at the New York Juvenile Asylum.

to the proper temperature. Two hundred and eighty-one children are bathed each hour, while by the plunge-bath only eighty could be bathed in the same space. The consumption of water is reduced to one-eighth by exact measurement.

The Association for Improving the Condition of the Poor of New York has also adopted this plan at my suggestion, and is now constructing a public bath on the Centre Market Place, which, it is hoped, will be an example followed by the authorities of this and other cities. The cheapness and practical utility of these baths must commend them to those having the care of the health of communities or large institutions.

Hydrotherapy in Disease.

The therapeutic value of water is established by the most convincing evidence, obtained at the bedside in all countries and in all epochs of

the history of medicine. While other remedies which have been heralded as prolific of good have been cast into everlasting oblivion, or have from time to time enjoyed a more prolonged reputation, water is the only remedy which has stood the test of time since Hippocrates furnished medical literature with the first treatise on the subject. Bloodletting, which from the earliest dawn of medicine rallied the best minds to its support, and for some time towered above all other methods of treatment and resisted the onslaughts of its few yet able opponents, lost its foothold so soon as the light of modern research exposed the fallacious reasoning upon which it is based. Water, on the other hand, whose paternity is coeval with this once universal remedy, but which never approached the same complete dominance, is to-day more highly esteemed than ever by some of the best clinical observers. The more fiercely the light of modern research beams upon it, the more glaring become its points of vantage, because its application is based upon well-recognized physiological principles. The verdict of history is pronounced in favor of water as a valuable (but not universal, as the hydropaths would make it) remedy. That in all epochs the most brilliant minds advocated its use most earnestly a brief reference to history will demonstrate. Hippocrates devoted one of his books to the discussion of water as a remedy. His acute observations demonstrate the principles of hydrotherapy in an empirical but correct manner. He discovered the stimulating or warming effect of cold water and the soothing effect of warm water, and utilized the former in syncope and the latter in insomnia; he discovered the diuretic effect of the cold bath in fever, and even insists that it is more useful in inflammation of the lungs than in ordinary fevers, because it renders the expectoration more fluid and relieves dyspnœa and pain in the side. Asclepiades of Prusa, whose brilliant accomplishments made him the intimate of Cicero, and who was the founder of the school which furnished men like Themison, Antonius Musa, and Celsus, was an ardent advocate of water as a remedy. In his *De re Medica*, third book, Celsus recommends cold ablutions and the cold bath in fevers, and insists upon their early application. Galen too, frequently advises the use of cold water, and the use of cold affusions to the head while the patient sits in warm water—a method to-day resorted to in the collapse, coma, or in the somnolence of fevers—originated with him. In his seventeenth book the directions for treating fevers by cold are marvellously clear; they could be literally transcribed and utilized to-day. His theory of hyperpyrexia and its treatment is in accord with that now accepted. He says the only cure of fevers is by abstraction of heat after the cause is removed.

A great cyclopædia of the medical sciences, published by Oribasius

in A. D. 360, contained a chapter on "Febris Exacerbatio balneis naturalibus curata."

Rhazes ordered in measles that "as soon as dyspnœa becomes very great a cold bath must be given, and the body must be well rubbed until the eruption appears." We cannot improve upon these suggestions at the present time.

That the use of water was popular among the Arabian physicians is testified by Prosper Alpinus, who visited Egypt in 1580, and observed that "the people take a lukewarm bath for refreshment, often dipping themselves afterward in cold water; not only the well, but those sick with fever, do this." Thus had the doctrines of the Alexandrian School, which utilized baths and cold drink in fevers, been transplanted into Egypt and endured a long time.

In the seventeenth century we find the great Dutch physician Herman Vander Heyden a warm advocate of water in disease. His 363 cases of malignant dysentery recovering under hydrotherapy are among the most brilliant achievements in clinical medicine. Van Helmont also used water extensively.

England has contributed probably as much as any other country to the dissemination of hydrotherapy. Floyer's *Inquiry into the Right Uses of Hot, Cold, and Temperate Baths*, published in 1697, is a classic which has been translated into all modern tongues. The practice of hydrotherapy was warmly adopted by Baynard, Blair, Brown, Pitcairn, Cheyne, Huxham, and other eminent practitioners, chiefly in acute diseases.

Floyer's learned treatise made such an impression upon Friedrich Hoffman that the latter taught this doctrine and practice from his university chair, basing the action of cold water chiefly upon the effects upon the tone of the blood-vessels. Thus was it disseminated among educated physicians in Germany. Later, such men as Van Swieten and the Hahns, father and son, espoused hydrotherapy as a part of their practice in acute and chronic diseases, especially in the exanthematous fevers.

The exploits of Wright and Currie, which were published in the last years of the eighteenth century, are to English and American physicians the most familiar historical facts connected with hydrotherapy. How correctly Currie estimated its rationale in typhus and low forms of scarlatina is evident from the following passage: "We are not here to await the good offices of Nature and assist her supposed efforts, but to combat the fever in all its stages with our best powers;" and he used cold sea-water, 37° F., because of its greater irritating effect, which produces reaction. A proof of the proselyting influence of the work is cited by Pollak, to whom I am indebted for many historical data. Franck, who was an enthusiastic apostle and studied

under Currie, introduced his methods into the Viennese Hospital, where they have since held almost constant sway under men like Hirschel, Froehlich, Mauthier, Plith, Plennger, Dumreicher Friedman, Rosenthal, and, last and far from least, the father of scientific hydrotherapy, Wilhelm Winternitz.

The eminent Italian physician Joseph Giannini says: "Humanity owes Currie a debt of gratitude for having brought to a correct light so excellent a procedure, and having so bravely taken up the battle against prejudices." This practitioner discovered the value of full baths, which he advised night and day when required by high fever, and thus laid the foundation of the great triumph of the Brand treatment of to-day.

As one name among many illustrious advocates of hydrotherapy in Germany must be remembered Hufeland the philosophical physician, who was so deeply interested in the subject that he offered a prize of fifty ducats for the best essay, which was carried away by Froehlich, the Austrian court-physician, who demonstrated his great confidence in hydrotherapy by insisting that it was capable of shortening typhus if used in the very inception of the disease.

During the past thirty years, which may be regarded as the most eventful epoch of medical history—a period during which the doctrines of schools were displaced by the exactness with which instruments of precision invested diagnosis, by the light thrown upon disease by pathological and microscopical study, and by the great chemical discoveries which promise to bring therapeutics abreast of diagnosis—water has risen to a higher status than ever before. In every country where medicine is cultivated assiduously there are men of acknowledged ability as clinical observers who are not only warm but energetic advocates of hydrotherapy. Semmola and Cantani in Italy, Liebermeister, Ziemssen, and Strümpell in Germany, Dujardin-Beaumetz and Glenard in France,—these are names which stand as vouchers for any therapeutic method, and bid us carefully scrutinize it ere we are moved by prejudice to reject it.

While the modern practitioner happily owes allegiance to no school and is not under the thraldom of any authority, let him not disregard the clinical results, based upon rational principles, which are recorded on the subject of hydrotherapy.

To bring the American physician more *en rapport* with the justly eminent advocates of this method is the aim of this article.

Rationale of the Action of Water.

The action of water as a remedial agent may be explained upon strict physical and physiological principles. Its effect upon the body is traceable—first, to mechanical impact; second, to temperature effects.

These effects are modified in accordance with the part to which the application is made, the condition of the individual, and his environment. As an illustration may be mentioned the effect of an application of melting ice to the toes in a healthy individual while awake or asleep, drunk or sober. The mechanical impact produced by friction of the water from a douche—which is a stream propelled with force by two or more atmospheres—will produce the effect of massage of the part.

Tuerck has shown that anæsthesia of the skin may be removed by gentle rubbing, and that friction or pressure acts upon the peripheral circulation is constantly observed. Stroking the skin with the fingers leaves pale lines, resulting from the driving of blood from the superficial vessels, which, however, immediately disappear. This effect produced by mechanical impact upon the peripheral vaso-motor nerves, both stimulating and relaxing them, is conveyed to the central nervous system, which responds by effects upon the respiration, the cardiac movement, the distribution of the blood, and the vascular tension. Thus the local disturbance of the circulation by mechanical impact of fluids becomes an important factor in hydrotherapy, to which reference will be made later.

Second, the temperature effect produced by water is really the chief element in its therapeutic application. To realize fully the importance of this proposition reference need only be had to the anatomy and physiology of the skin as it is revealed by modern researches. Briefly and simply told, the skin presents not only the most extensive continuous vascular and nervous area of the body, but it is the most accessible surface to all external impressions. Herein may be sought the relation and importance of the skin to all the systemic functions. The large cutaneous surface stands guard, as it were, over the entire body. Being a sensory organ, it receives all impressions of irritants, be they thermic, mechanical, chemical, or electrical, which may combine all.

Thermic irritants, heat and cold, are the chief elements in all hydriatic procedures. They make impressions upon the terminal nerve-endings which abound upon the cutaneous surface. The sensory impressions act in a twofold manner: First, they are conveyed to the central nervous system, whence reflexes are emitted which have the most important bearings upon all the functions of the body. Second, the effect upon the vaso-motor nerves produces a narrowing of the surface vessels, which increases the resistance to the circulatory current and thus raises the blood-pressure. This constriction is followed, in accordance with familiar physiological laws, by relaxation; and this effect depends, in turn, upon the extent and intensity of the irritation.

These simple and briefly-stated physiological facts furnish an explanation of the seemingly paradoxical effects of hydriatic procedures. They also furnish the key to the remarkable yet positive

effects which the latter are capable of producing upon the respiration, circulation, tissue-metabolism, secretion, and temperature-changes of the human organism.

Effect of Peripheral Irritation upon the Respiration.—At the very dawn of life we are forcibly reminded of the influence of cutaneous irritants upon the respiration. The first inspiration is due partly, if not chiefly, to the impact of colder air upon the surface of the infant; and a most reliable measure for the establishment of retarded inspiration, and for its maintenance when feeble, is the dashing of cold water upon the cutaneous surfaces, and, that failing, the rapid variation of hot and cold impressions (by dipping in warm and cold water) upon it. The familiar example presented by the ordinary treatment of syncope, by dashing cold water upon the exposed body, is another illustration of the powerful influence of thermic irritants upon the respiratory innervation. That heat produces the same effect as cold has recently been the experience of the writer. After an operation for an abscess an extremely sensitive male patient swooned away, presenting tonic contraction of the muscles and complete cessation of respiration and pulse. Dashing an entire basin of cold water (about 65°) upon the face produced not the slightest effect. A pitcher of hot water being convenient, I poured about an ounce on one leg which was hanging lifeless over the edge of the bed. The patient at once was aroused to consciousness, but he suffered from a burn for several days.

The first effect of cold upon the terminal nerve-endings with which we shall have chiefly to deal in this article is the conveyance of the irritant impulse to the respiratory centres, producing a gasping respiration, which gradually deepens and becomes more rapid. It is difficult to separate the effect upon the respiration from that upon the circulation. The proportion which exists between the number of pulsations and respirations is usually changed by the application of cold. Deep inspiration must facilitate the general circulation, while it offers a certain resistance to the internal circulation. Complete expirations have the opposite effect. Whatever influence, therefore, is brought to bear upon respiration must to a greater or less degree affect the circulation also. The deepening of the inspiration by cold upon the surface, if not excessive, is so well established by daily observation that it requires only this brief reference. Even the empirics have recognized this fact, inasmuch as they invariably order the patient to go into the open air after most hydriatic procedures. The deepened involuntary inspirations enable the patient to obtain a large supply of oxygen, which, after all, is the chief life-giving element in nature, and when abundantly but not artificially supplied to the lungs excels all medicinal tonics in restoring the functions to a vigorous norm.

Effect of Peripheral Irritation upon the Circulation.—This effect

is local and general. The first result of a local application of cold or of extreme heat is contraction of all the muscular tissues coming in contact with it. Hence the muscular fibres of the skin, as well as the circular fibres of the cutaneous vessels, are contracted, with the result that the latter are emptied, as is evidenced by the pallor and shrivelled condition assumed by the skin. In this way we have the washerwoman's hand from heat and the cutis anserina from cold. At this point comes into play the physiological action of all organic muscular fibres. The latter respond slowly to stimuli and recover from this action with equal tardiness. Still, even this effect may be modified by the intensity and duration of the application. The more intense the latter, the more rapidly will the vessels contract and become anæmic. A brief application will result in rapid reaction, while if the application be continued reaction will be interfered with; paralysis of the vaso-constrictors will result from over-stimulation; the vessels will dilate; the skin will become red, and lastly, cyanotic. The vitality of the part may thus be reduced, when anæsthesia results, and if the cold be continued destruction of the part ensues.

Thus we may induce in the circulation innervation and nutrition of the part by the simple application of cold to any portion of the periphery, a powerful change either for good or for evil. The immense latitude of effect between the application of moderate and extreme cold is made evident at once. Extreme heat, it should be remembered, produces an analogous effect.

The cardinal point to be remembered here is that *a brief and intense application of cold is a stimulant, because it is at once followed by a corresponding reaction, while a prolonged application is a depressant.* And in the practical application of hydriatic procedures, this fact will be frequently recognized.

The general effect upon the circulation produced by cold must necessarily be traced to its impression upon the heart. Among the numerous positive and valuable contributions to scientific hydrotherapy, for which we are indebted to Winternitz, the effect of thermal stimulants upon the heart stands foremost. By means of sphygmographic tracings he learned that cold applied to the surface produced an immediate cardiac response by increasing the pulsations, but was immediately followed by a slowing of the heart's action. The opposite effect resulted from the application of high temperatures to the surface; and here, again, the effect, being reflex, depended upon the susceptibility of the individual to impressions.

The classical experiments of Naumann, in which the trunk of a frog was left connected with the leg only by means of the sciatic nerve, clearly proved that thermic and other stimuli applied to the web produced an immediate change in the circulation of the mesentery. From

these experiments he justly concluded that the irritants applied to the surface act upon remote parts by a reflex wave from the central nervous system; that intense stimulation of the surface diminishes the cardiac force and activity, dilates the vessels, and slows the blood-current; that weak stimulation of the surface increases cardiac activity, improves the force of the heart, diminishes the calibre of the vessels, and accelerates the blood-current; and that these effects continue for some time, according to the intensity and duration of the application.

That this effect upon the heart may be produced by other channels also is shown by the fact that in the heart removed from the body of an animal the application of cold produces a diminution, and that of heat an increase, in its contractions, and by the observation that the passage of cold or hot fluids through the heart has a similar effect when it is still connected with the body. Thus, it is demonstrable that the cooling or heating of the blood-current distinctly affects the cardiac nerve-ganglia.

Aside from the direct effect upon the innervation of the heart, the action of the latter may be, and is readily, influenced in two other directions. Pulse-tracings demonstrate that inasmuch as by cold impulses are conveyed from the periphery through the sensory and returned through the motor tracts, a reflex stimulant effect upon the force of the heart may be produced which offers many valuable hints in the treatment of organic and functional cardiac trouble. Moreover, a very important channel through which cardiac activity and force may be enhanced is to be sought in the relations existing between the peripheral and capillary circulation. One of the important agencies in controlling the frequency of the pulse is the resistance offered to the current of blood by the arterioles and capillaries. This resistance diminishes the frequency and increases the force of the systole, while diminution of the resistance of the arterioles and capillaries increases it.

Clinical demonstration of this effect is constantly observed in fevers. The rapid, dicrotic pulse, due to a lack of resistance in the peripheral vessels, as will be shown later, is at once changed into a more deliberate pulse of almost normal tension by the appropriate application of the cold bath. The latter acts, not by narrowing the cutaneous vessels, as is generally supposed, but by stimulating them to resume their functions of contracting upon the blood, which has been flowing through them as through a dead or paralyzed tube. This restoration of normal resistance in the arterio-capillaries restores the lost equilibrium between the latter and the heart. The cardiac systole becomes normal, the pulse slower and more natural. This effect I have often observed in typhoid fever, as will be shown later.

It is important to note the modifying influences arising from the impressionability of the individual, the condition of his health, the

character of the disease, the method of application, and the intensity of the thermal irritant. E. Delmas Saint-Hilaire[1] has shown as the result of thermometric and sphygmographic experiments that all physiological and therapeutic manifestations produced by cold are to be explained by the impression transmitted to the nerve-centres from the peripheral nerve-endings. This primary thermo-dynamic action upon the nerve-centres is at first transferred to the respiration and circulation.

The Reflex Effect of Cold upon Cardiac Action.—This effect is frequently manifested by rapid contractions, and generally by a considerable rise of arterial tension. Shortly afterward, however, the frequency of the pulse diminishes, falling below the previous number, while the heightened tension in the vessels continues to exist. The effect of cold upon the cardiac action and the peripheral vessels depends also upon the subsequent muscular quiescence or activity of the individual. If the latter remains quiet, the heart-action is accelerated at first, but quiets down afterward. If he exercises, the pulse becomes more slow at first. The more quickly exercise follows upon the douche, the greater will be the fall of temperature, slowing of pulse, and diminution of arterial tension. The tension of the pulse is greatest at the moment of impact, when the heart-action is most rapid; as the latter diminishes the tension is also lower, but does not fall so low as it was before the douche. So soon as reaction takes place and the peripheral surfaces are warmed, the frequency of the pulse diminishes.

Physiological experiment explains these effects. When the sympathetic nerve is divided the intestinal vessels become distended with blood through inhibition of the power of the constrictors, while the dilators, which are probably of spinal origin, remain active. The result is a loss of tone in the entire vascular system, which endeavors to accommodate itself to the abnormal distribution of blood. Even in the vessels of the retina Basch and Hock have observed contraction, and consequent anæmia, when the sympathetic nerve was divided. In the same manner may the intestinal and retinal vessels be rendered anæmic by irritating the terminal fibres of the divided sympathetic. We have here an explanation demonstrated by actual physiological experiment, and not resting only upon plausible theory or clinical observation.

As additional evidence of the effect of peripheral irritants, Max Schueller's experiments may be referred to, which offer the most incontrovertible evidence of the influence of thermic irritants on the circulation in various parts. After trephining a rabbit without injuring the dura mater, Schueller observed through the transparent cerebral cover-

[1] *Étude statistique et clinique du Service hydrotherapeutique de l'Hôpital St. Andral de Bordeaux, etc.*, Paris, 1879.

ings the normal condition of the vessels of the pia mater. He then removed the superior ganglion of the sympathetic on one side, and applied pieces of ice upon the dura mater without any material effect upon the subjacent vessels; while a similar application upon the other side produced energetic contraction of the vessels, which continued for half a minute after the removal of the ice. In another trephined animal Schueller observed the circulation in the pia mater during various other hydriatic processes. A cold compress placed upon the animal's belly or back immediately produced continuous dilatation of the veins and arteries; the cerebral pulsation became more slow and pronounced; the respiration was deepened and retarded. This remarkable phenomenon continued a few seconds after removal of the compresses, and was followed by an evanescent narrowing of the vessels before their resumption of normal calibre.

When heat was used it was found that a warm, moist compress applied to the belly or back produced narrowing of the vessels of the pia mater and diminution of energy in the pulsations, while the latter were rendered more frequent and the respiration became shallow and accelerated. A very hot compress applied to the belly produced temporarily the same effect as a cold one. When the body of the rabbit was placed in a bath the same effect was observed, being governed in extent by the extent of surface exposed and the temperature of the water.

Schueller tested all hydriatic procedures in this manner, and thus established their value upon an exact scientific basis.

It follows from these well-ascertained facts that *by means of hydrotherapy we may exercise perfect control of the pressure and distribution of the blood.* But it must be remembered that the various compensatory provisions which exist for the preservation of the systemic equilibrium decidedly oppose a too active interference with the elements constituting the hydraulic apparatus which is represented by the heart and blood-vessels. We know, for instance, how the distribution of blood to the organs is governed by their activity, and that *it may be increased or diminished from ten to twenty times.* It has been asserted that when the vessels of the skin are filled to their utmost capacity they may contain 66 per cent. of the entire quantity of blood in the system.

Winternitz has shown by means of the plethysmograph, which measures and records the volume of parts with precision, that an increase of volume due to the afflux of blood to the part may be readily produced in individuals subjected to various hydriatic procedures. The left arm of a man sitting in an empty tub was placed in the instrument. When the lower part of the body was covered with water at 50° F., the tracing made by the instrument at once recorded an increase of volume in the arm, which continued twenty seconds, and

gradually diminished without returning to its original proportions. The opposite effect was produced by warm sitz-baths.

These brief yet positive data suffice to explain not only by theoretical and empirical observation, but upon an exact physiological basis, the enormous influence which hydriatic applications to the periphery may exercise upon the blood-supply, blood-pressure, and consequently upon the action of the heart.

Influence of Peripheral Irritation on Temperature-changes.— The effect of hydriatic procedures upon the systemic temperature has long been observed as the most palpable evidence of its power upon the human organism. Indeed, it was the first observation recorded by Hippocrates, and has since been so constantly reaffirmed without successful contradiction that it has become axiomatic. *A priori*, it would appear that this temperature effect is due to the effort at equalization of temperature which constantly ensues when two bodies of unequal temperature are brought into intimate contact. While this is the case in inanimate bodies, the result is quite different when the human body is subjected to temperatures differing from its own. Parts distant from the heart are more readily cooled, as are also parts whose volume in proportion to its surface is small. Indeed, it is the activity of the circulation in a part which governs its amenability to temperatures with which it may come into contact. The heat which accumulates within organs during a state of activity is not simply radiated to neighboring parts, but it is distributed to other parts of the body by means of the circulation of the blood. This is clearly demonstrable by the fact that the venous blood from the muscles or organs when functionally active is warmer than the arterial blood supplying them.

The temperature prevailing in the skin depends upon the quantity of arterial blood circulating within it. Hence the contraction and dilatation of the peripheral vessels are the chief elements in resisting cold and heat which may come into contact with them. Very little heat is produced within the skin. It derives heat, not only from the vascular tide passing through it from within, but to some extent also by direct conduction from neighboring parts. Hence the heat given off by the skin is subject to many changes. It is also influenced by the thickness of the epidermis in certain parts, and by accumulations of fat or of fluids beneath it. Therefore, thin persons cool off more rapidly than those who have an abundance of adipose tissue. Ranke says that the activity in connective tissue is less than it is in the muscular or glandular tissues, and therefore the temperature of the skin, which consists chiefly of connective tissue, is somewhat lower than that of other parts or organs. Although constant cooling going on upon the skin prevents exact deduction upon this point, it is certain that the heat-production of the skin is compensated by the heat-loss from its

surface. This is proved by the temperature of the blood in the superficial veins, which is below that of the arteries. The arterial circulation must therefore be regarded in the skin, as in other parts of the body, as the most essential source of heat.

That the rise and fall of temperature in the human body depend upon its arterial blood-supply has been also demonstrated by Max Busch, who found, when cooling off a part of the skin, a corresponding rise in the neighboring parts, due to anæmia of the former and collateral hyperæmia of the latter. This, however, was followed by a dilatation of the arterioles, which is called reaction. Contrary, therefore, to the law governing inanimate objects, *the temperature of the human body never can be reduced or raised to that of its surrounding medium unless the vitality of the part exposed be destroyed.*

The entire heat-regulating arrangement residing in the skin is now made plain, and the protection enjoyed against serious temperature-invasions by the viscera, which are surrounded by muscles, is clearly accounted for.

That the human body may have its temperature elevated or lowered by being surrounded by hotter or colder media is an indisputable fact, established by many experiments, as is also its automatic protection against heat-increase and heat-loss. The application of intense heat to the surface produces contraction of the arterioles, which may go on to destruction of the tissues by withdrawal of vascular and nerve-supply. A more moderate degree of heat produces a relaxation of the surface vessels, which lose tone; the part becomes succulent, warm, and red from retarded circulation, which protects the inner organs against too rapid heating. If the surrounding medium is less hot, the surface circulation becomes more active, more heat is given off, and thus the blood brought to the surface, being cooled again, serves to protect the inner organs against too great an invasion of the heat.

On the other hand, if the body is surrounded by a temperature lower than its own, the effect again depends upon the cooling. The same change occurs from intense cold as from intense heat. Both may so contract the peripheral vessels as to destroy the vitality of the part. A less intense degree of cold applied to the skin acts, however, differently from heat, as it contracts the arterioles and capillaries, and thus weakens the force of the peripheral circulation. At the same time the blood is driven into the underlying muscles, which are endowed with more heat, and thus offer an obstruction to the invasion of injurious degrees of cold. The protection is enhanced by the reflex effect of cold applied to the surface, which produces a dilatation of the vessels supplying the muscles, and by the resultant generation of heat. As Adamkiewicz has shown, the feeble heat-conducting power

of muscular tissue adds another element to the forces which tend to protect the inner organs against dangerous invasions of cold.

It has already been shown how completely the circulation of the periphery is under the influence of the central nervous system, and how the latter may be called upon to receive impressions from the periphery and convey them back to the latter, thus completely controlling the amount of blood circulating in the skin.

It having now been demonstrated that the temperature of various parts of the body is dependent chiefly upon the amount and the rapidity of the circulation within it, it follows that the central nervous system is capable of controlling the temperature of various parts. In the skin, for instance, chilliness is a manifestation of this influence. The cutaneous vessels are contracted, heat is no longer given off freely; it is retained, and the body is protected against cold. Hence the first stage of febrile movements is a rigor. Upon this principle it would seem that the reduction of temperature by external cold application is not a reliable phenomenon. Indeed, it is held, and justly too, by some that the application of cold to the periphery produces an elevation of the body temperature by the collateral hyperæmia and consequent increase of tissue-change. Hoppe has clearly demonstrated that in a healthy man placed in a bath of 69° for a brief time the axillary temperature rises somewhat; and Juergensen has recorded a slight rise of the temperature in the mouth *during* a bath of 86° F. which lasted twenty-five minutes. This increase of temperature resulting from cold baths is constantly utilized in the treatment of chronic diseases, as will be shown later on.

Winternitz has so clearly given us an explanation of the apparent inconsistency involved in these observations that it may now be regarded as a law, that *the absolute amount of heat-abstraction does not fix the amount of heat-production, but that this is regulated by the intensity of thermic irritation of the peripheral sensory nerves.* The latter cause and control the increased heat-production by reflex action. Two cold baths of exactly the same temperature may have quite different effects upon the same individual. If the body is submerged in water of, say, 60° F., the surface is rapidly cooled, the sensory nerve-endings are stimulated, the blood is driven to the muscles, and more heat is generated within the latter. If, on the other hand, the body while submerged is constantly subjected to active frictions, the cooling will be more slow and gradual, the cutaneous vessels will convey cooled blood to the interior, and counteract also the increase of temperature by diminishing the reflex action from the surface which is the incentive of muscular heat-generation. This subject will again be referred to in the discussion of cold baths. *It only suffices here to establish the fact that the temperature of the body may, within certain limits, undoubtedly be reduced or*

raised by temperatures conveyed to it by means of water or air. This has been well established by the experiments of Liebermeister, König, and Juergensen.

But the fact must not be lost sight of that changes of temperature wrought upon the human body are *compensated* for, when the influencing thermal agent is withdrawn, by a return of the previous temperature to the normal, or by an approach to it, according to the previous condition of the body, the nature of the disease, and other agencies to be referred to later. While during the bath of from 69° to 86° the normal temperature rises, a reduction is observed after the bath, which may again, according to Juergensen, be succeeded by a compensating feeble rise. Thus, in a healthy man subjected to a bath of 95° for from fifteen to twenty-five minutes the loss of heat was equal to the normal; when the water was reduced to 77° the heat-loss was trebled, and in a bath of 68° the quantity of heat-loss amounted to five times the normal.

The influence of heat-media surrounding the body is equally pronounced. Mosler records in a bath of from 104° to 111° F. of fifty-five minutes' duration a rise to 101.6° in the mouth, and Bartels reports the rise of rectal temperature from a ten minutes' vapor-bath of 127° F. as amounting to four degrees. The writer has often seen mouth-temperature rise one degree more in the hot-air bath at the Montefiore Home, in which the head is not at all exposed to the hot air.

It would be seen that the cooling and heating effects of the baths depend upon the method, the length of time of immersion, the degree of their temperature, and the manner in which the system is capable of protecting itself against the temperature invasion. The flexibility of hydriatic procedures is thus manifested in their influence upon temperature reduction or elevation.

Effect of Peripheral Irritation on Tissue-Metamorphosis.—Ranke has enunciated the law that though the quantity of plasma and circulating albumin is constant, its production depends upon the quiescence or activity of the organs. He and Voit demonstrated that function is always connected with increased circulation in the organs, and that tissue-change is coincident with circulating activity. As the blood is the chief carrier of material for tissue-metamorphosis, it follows that any procedure by which the distribution of blood may be controlled must influence more or less the tissue-changes. And when it is considered that temperature-changes are either the cause or effect of tissue-changes, any measures which control this important factor must aid in influencing tissue-metamorphosis. That cold reduces and heat increases cell-activity is axiomatic. But these are *direct* effects, which do not so frequently come within the therapeutic domain as the *indirect* results produced by reflex agencies, and which are paradoxically contrary to these. From the cautious experiments of Liebermeister the fact has

been deduced that oxidation, as ascertained by the excretion of CO_2, is enhanced by the external application of cold and diminished by the external application of heat, *so long as the body temperature is not much disturbed.* As soon as the body temperature is reduced below or raised above the normal—which proceeding must decidedly and enduringly influence the internal temperature of the body—we have the *direct* retarding or enhancing influence referred to.

That an increased consumption of oxygen is a manifestation of the application of cold has been clearly shown by Röhrig and Zuntz.

Voit has also established the fact, and Pflüger, Samuel, Colosanti, and others have confirmed it, that non-nitrogenous matters undergo changes under the application of cold to the sensory nerves, which produces reflex contraction of the muscles. The same experimenters have shown that the opposite effect is produced by the application of heat. This, however, is limited by the degree of heat, for a very high degree will promote tissue-change, as manifested by increase of oxygen-consumption and carbonic-acid elimination, as has been shown to be the result of very long-continued low temperature. Bartels has shown that whenever the body temperature is increased by vapor or other baths, there is more urea excreted, evidencing that nitrogenized tissues participate in the conversion thus produced.

We have, then, proofs from reliable experiments that *rapid cold baths accelerate the tissue-changes* in non-nitrogenous substances, while hot baths affect not only these, but also *albumin conversion;* and that if the inner temperature is reduced below the normal, the reverse effect results.

Winternitz declares that a fair estimate of the influence of hydriatic procedures upon tissue-changes may be deduced from the fact that among several thousand cases treated in his establishment, 56 per cent. gained weight, 30 per cent. lost, and in only 14 per cent. no change in weight occurred. He concludes that it cannot be denied that the thermal and mechanical influences which compose hydrotherapy produce in the majority of cases such *changes in tissue-metamorphosis* that eventually an increase of flesh results.

Inasmuch as, according to all experimental researches, abstraction of heat produces an increased excretion of CO_2, and a larger quantity of oxygen is taken up; and as the products of retrograde metamorphosis from nitrogenous matters appear abundantly during the period of reaction, as well as salts and inorganic material, and despite these effects the body-weight seems to increase in a large proportion of cases, the conclusion is unavoidable that hydriatic treatment not only increases retrograde metamorphosis in all directions, but also enhances the building up of tissue. Therefore, this hydrotherapy is capable of *promoting tissue-change* in every direction.

My clinical observation in the Montefiore Home, which receives only incurable cases, confirms the views of Winternitz, that an improvement in the general condition and weight of a large number of cases, whose hopelessness has been attested by previous unsuccessful treatment and by every diagnostic sign, is proof that cold-water applications, carefully adapted to each case, improve the appetite, deepen the respiration, refresh every organ, and thus infuse an increased energy into the glandular and other functions which contribute to tissue-metamorphosis. The effect of temperature-enhancing procedures are, as has been already shown, equally striking. The action of the heart and the respiration are accelerated, the blood-pressure and blood-distribution are notably changed; and these marked alterations must make a decided impression upon the nutritive processes. Anton Frey[1] gives as the result of numerous experiments with Turkish baths a positive increase of urea. Still more pronounced is the change of uric-acid excretion under Turkish and Russian baths, amounting sometimes to a threefold increase. The increase is greatest immediately after the bath, but is demonstrable even several days afterward. The quantity of phosphoric and sulphuric acid is also increased.

Godlewsky's exact experiments, quoted by Frey, demonstrate conclusively that Turkish baths induce a positive acceleration of oxidation of nitrogenous substances (nutrient and tissue albumin), which continues several days. That non-nitrogenous substances may also be converted by these baths is constantly observed in the fact that corpulence may be reduced by them if the supply of fatty foods and fluids is diminished. Experiments on animals also have demonstrated this.

Another evidence of the enhancing effect of these baths upon tissue-change is found in the increased absorption of oxygen by the blood and by the excretion of more carbonic acid. These effects are greatly enhanced by the temperature-reducing procedures which are a part of the Turkish bath. The great loss of salts and water resulting from the hot-air bath must affect the composition of the blood, which must compensate the loss by drawing upon the tissues and intercellular fluids. It is reasonable to suppose that this active process induces pronounced changes in the parts involved, and thus influences tissue-change. Indeed, it has been definitely determined by C. Schmidt (quoted by Winternitz) that the withdrawal of salts, and especially of alkaline chlorides, from the blood is followed by a diffusion of albumin from the tissue-fluids. Schmidt has ascertained that there exists between the blood-salts and the plasma-albumin a constant reciprocal relation of equivalents—viz. that the blood takes up for every nine parts of albumin one part of salt; the reverse also holds good. Hence the blood-plasma must become much richer in albumin after sweating. It cannot

[1] *Volkman's Sammlung*, 332 S., p. 3018.

be disputed that such a change in the chemical constituents of the blood must contribute to the acceleration of tissue-metabolism, as evidenced by the increased absorption of oxygen and excretion of carbonic acid and nitrogen. The recent remarkable contributions by Scholz [1] to the treatment of chlorosis by sweat-baths may be cited as clinical proof of this physiological phenomenon. His sphygmographic charts and exact records are entitled to proper consideration.

Another element contributing to acceleration of tissue-changes is *muscular activity*. This has become an axiom in physiology, and it has been shown how cold applications increase the action of muscular fibres by reflex channels.

We have therefore a truly physiological basis for the statement that hydrotherapeutic procedures increase tissue-metamorphosis.

Influence of Baths upon the Blood.—In connection with the influence of hydriatic measures upon tissue-metabolism, and its effect upon those important physiological processes which constitute the blood-making and maintaining functions, M. Thermes presented in 1878 a paper to the Société d'Hydrologie, the results of his careful measurements with Hayem's hæmometer, which demonstrated conclusively that by the judicious application of cold to the periphery the number of the blood-corpuscles was increased and their quality much improved.

Winternitz has also demonstrated with precision, by means of Fleischl's hæmoglobinometer, that the oxyhæmoglobin of the blood is rapidly and considerably augmented under appropriate hydriatic procedures.

Technique of Hydrotherapy.

The first principle of all hydriatic procedures which the reader should impress indelibly upon his mind is the necessity of an exact and precise execution of their technique. The flexibility of hydrotherapy is so remarkable that the most contradictory results may be obtained from procedures apparently similar, and the object aimed at may be totally defeated by imperfect or improper methods. In a paper read before the New York State Medical Society in 1889, I mentioned the case of a young but able hospital physician and teacher who expressed abhorrence of the bath treatment of typhoid fever because he had seen, while an interne, a nurse in his hospital succumb to it under the management of his able visiting physician, who was also a professor of the practice of medicine. When I asked him to explain the method adopted, he replied: "We endeavored to reduce the temperature by wrapping her in a sheet, placing her on a Kilbe's cot, and sprinkling her with ice-water." That such a proceeding contributed to the death of the woman I have no doubt. The brief

[1] *Die Behandlung der Bleichsucht mit Schwitzbäden*, etc., von D. Fried. Scholz, Bremen-Leipzig, E. H. Mayer, 1890.

physiological data above given will explain how the blood was driven from the surface to the inner organs, and, there being no effort made to obtain reaction by friction, the poor woman had her life-blood almost frozen in the peripheral vessels, whose coats were paralyzed rather than stimulated, as will be shown later on. The most ignorant hydropathic nurse understands that an *iced sheet* should never be wrapped around a patient without active friction; and here was an otherwise excellent teacher of medicine violating the most palpable rules of the water-treatment and infusing a prejudice against it in the mind of a young man which later years have not removed, because he would not try cold water at all. Thus erroneously have many capable men argued upon hydrotherapy and fostered the prejudice which the lay and medical public entertains against cold water. Even in the application of so simple a procedure as an enema, which depends for its effect upon mechanical distension, the mistake of using too small a quantity of water will, as every one knows, defeat the object. Instances of misapplication of hydriatic procedures come under my daily observation. Is it, then, to be wondered at that so many failures are reported when men regard the use of cold water as the only or chief principle of hydrotherapy? Hydrotherapy is a term applicable to the utilization of water in any form, of any temperature, by various media or alone. Modern medicine has enlarged the field of hydrotherapy, inasmuch as it now includes the injection of hot water into the various cavities of the body—of the stomach for certain forms of dyspepsia, of the vagina for certain pelvic troubles, of the uterus for hæmorrhage, of the rectum for dysentery. These methods for local effects will be considered later.

The minute subdivisions of hydrotherapy introduced by the hydropaths, as head-baths, elbow-baths, and wrist-baths, will here be omitted, and only those methods described which the writer has found practically useful in his own experience or in the practice of others.

In order to win the profession over to a more general adoption of water as a remedial agent I have deemed it proper to simplify its application, and only refer here to the most approved methods, whose mode of action is simple and explicable upon rational principles. These methods are—1st, the ablution; 2d, the sheet bath; 3d, the wet pack; 4th, the dripping sheet; 5th, the half bath; 6th, the full bath; 7th, the douche; 8th, the sitz bath.

Ablution.—This is the most simple and yet least frequently used procedure for a therapeutic effect. To wash the face, hands, and neck is a daily practice with all civilized people. *This is a true ablution.* How rarely it is practised in disease will at once appear. True, many medical men who are not hydrophobic order sponging for their fever patients. This is refreshing if the nurse happens to understand that it consists of an ample application of water to the skin, and not a mere

sweeping of it with a damp sponge. Ablution is better practised with the bare hand or linen wash-rag, which may convey a dash of water into actual contact with the skin. The entire body may be gone over, and the moistened parts may be, in high fevers, allowed to dry, otherwise they should be gently mopped up by soft linen napkins to avoid reaction.

The *rationale* of this method is as follows: Friction being produced by the hand, the superficial vessels are somewhat dilated; the blood contained in them returns cooled to the interior, and is replaced by warm blood coming from it. Thus a most refreshing effect upon the innervation and circulation is produced, which is conveyed to the nerve-centres.

The *indications* for the use of ablutions are many. In the early stages of all febrile affections cautious ablutions are valuable. They serve to prepare the patient for more intense heat-abstractions, while they cool and refresh him for the time being. They also furnish a valuable index to the reactive capacity of the patient, which serves as a guide to future procedures.

A most important method which I adopted at first in very feeble patients, and now apply in all persons affected with chronic maladies who are prejudiced against water treatment (the vast majority), is the dry pack, followed by ablutions. The patient is snugly enveloped in a coarse woollen blanket for a sufficient length of time to become thoroughly warm. Each part of the body is now exposed in succession, subjected to ablution with water usually at 65° (reduced daily two degrees), and then dried. After the entire body has been gone over the patient is thoroughly rubbed dry again and sent out into the open air.

The next step in the hydrotherapeutic training of the patient follows in several days. He is made to stand nude in a tub of water at 98° or 100° while he is rapidly washed down by an attendant, or if strong enough does it himself, with water at 70°, gradually reduced daily to 50°; good drying and friction finish the procedure. In a few days he is prepared to undertake any of the more heroic procedures without shrinking.

The Sheet Bath.—This is a much neglected but exceedingly useful measure. It is well adapted to cases under the influence of elevated temperatures, and may be used, as will be shown later, as a refreshing agent in some chronic diseases. The technique consists in conveying cold water by the medium of a sheet or towel, of fine or coarse texture, placed upon the cutaneous surface. The patient is wrapped in a linen sheet, wrung not quite dry out of water at a temperature of from 60° to 70°, so that it clings to him at all points. When it is applied standing his feet may be placed in a tub containing water at 95°, to prevent chilling. This prac-

tice will be referred to later. The sheet bath I desire to describe now is to be applied in bed. A rubber cloth and a blanket having been spread to protect the bed, the wet sheet is placed upon it. The patient, after having his face washed and a wet towel wrapped around his head, is now laid upon the sheet with outstretched arms. The right side of the sheet is brought around his body, and so laid across it that its edge touches the sheet at the opposite side. The arms are now brought alongside the body; the left portion of the sheet is now brought over the left arm, across the body and right arm, and tucked in along the right side of the body, a fold being pressed in between the lower extremities and the upper corner tucked in around the neck.

By passing the flat hands over the entire body the wet sheet is made to cling to the irregularities, and its warmth soon indicates the rapid equalization of temperature between the sheet and body. Now small quantities of water are poured with one hand from a vessel or a sponge upon a limited part of the body, beginning with the chest. With the other extended hand rapid passes are made over this spot until it becomes a little warmer. Thus successive parts of the body are treated except the forearms, hands, legs and feet. This is continued until the sheet appears to be uniformly cooled off or the patient's teeth chatter. He is now removed upon another portion of the bed, dried, and made comfortable. It is in our power to modify the effect of such a bath by using a sheet of finer texture or making it more wet by pouring larger quantities of water over it. Care should be taken that the chilling produced by the first impression is not prolonged into a shivering, but that gentle reaction is always produced in one spot before another is treated. This can readily be done by not repeating the water application if the part is slow in warming or if it ceases to warm under the chafing hand. The wet towel around the head should receive an occasional affusion also.

The value of this bath is very great, and its rationale is as follows: A most useful and yet mild antifebrile effect is produced, which, following ablutions, will not antagonize the patient or his friends, and yet will afford a most intense antipyretic effect, arousing the dormant nerve-energies, brightening a dull patient, and improving those functions which depend upon quickly-responding nerve-centres for their integrity and efficiency. The first impression of cold upon the sensory nerves stimulates them, and the effect is rapidly conveyed to the nerve-centres, as described above. All the reflex effects of cold applications are thus evoked. The peripheral vessels contract, but dilate again under the chafing hand. Being filled with blood, the latter is cooled off by the cold water poured upon it, until the peripheral vessels again contract and drive the cooled blood within. Thus a constant gentle, because partial, abstraction of heat is established, which even feeble patients

may bear with impunity if the foregoing directions are judiciously followed.

In cases which do not possess facilities for bathing in tubs this sheet bath furnishes a good substitute for the full or partial baths to be described later. They may be given upon a cot or upon a blanket-covered table, or on the floor near the bed to avoid wetting the latter. In rural districts or in poor families great advantage will thus accrue to the patient, who may, if necessary, be deluged with water in this way.

In all febrile affections with high temperature, except in chest or abdominal diseases, this bath is applicable. In the exanthemata, when high temperature, with or without stupor and cyanosis, gives evidence of "suppression" of the eruption, the sheet bath with its attendant frictions is an admirable remedy, having the advantage over medicinal antipyretics that it stimulates the heart, deepens the inspiration, and increases oxygenation and diuresis, thus fulfilling other very important indications besides temperature-reduction. He who has seen a child with scarlatina tossing and moaning with a temperature of 104° or more, with mottled skin and shallow breathing and decreased urine, cooled and refreshed and enlivened by this bath, will never forget the relief and satisfaction derived from so simple a procedure.

In chronic affections, when the patient is too feeble to take the dripping sheet, this bath may be administered.

In feeble patients, partial sheet baths, made by placing fringeless towels over the trunk and treating it in sections as above described, will prepare the case for the full sheet bath or relieve local internal hyperæmia if applied over the affected part.

The flexibility of the procedure is self-evident. Modifications to fulfil various indications will suggest themselves to the physician who masters its rationale and objects.

The Wet Pack.—This application of water by means of a linen sheet is not, as is usually believed, the invention of the hydropaths, but was first suggested by Lucas, an English physician, in 1750.

Just as we modify the effect of powerful medicinal agents by the method of administration, so may the effect of water be modified, except that the changes which may thus be wrought are more numerous and the effects more striking.

The wet pack is *not really a wet sheet*, but a *damp sheet*, by the application of which we aim to envelop the patient in a vapor-bath of his own creation. It is applied as follows: A good blanket is smoothly placed upon a cot which has been covered with a hair mattress. A coarse linen sheet—or a linen tablecloth may be substituted, because of its being more apt to be found in most households—is now dipped in water varying from 70° to 50°, as may be indicated, always beginning

with the higher temperature and lowering it from two to six degrees daily. This sheet is now wrung out more or less according to the object

Fig. 129.

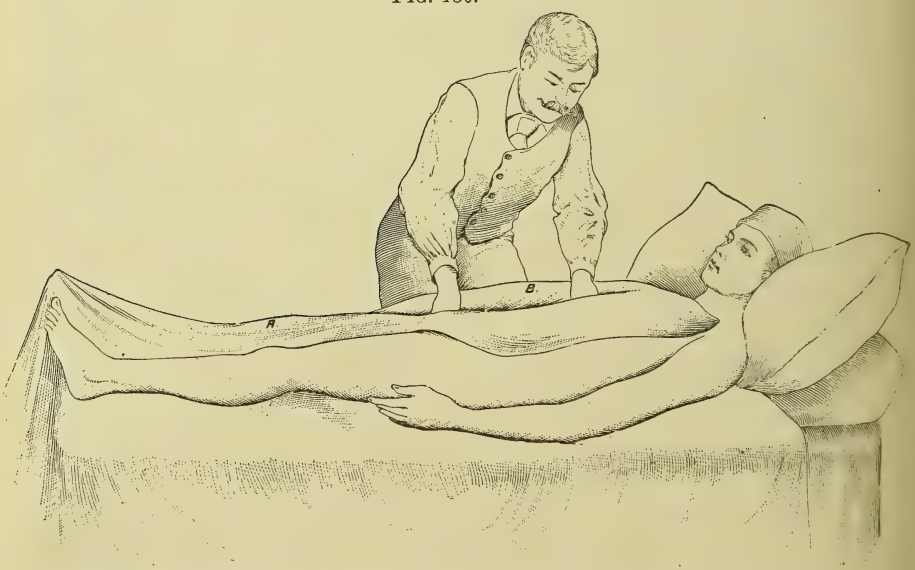


Cot prepared for Wet Pack. *A*, Blanket. *B*, Damp Sheet. *C*, Pillow.

in view, and is then opened and spread as smoothly as possible upon the blanket. (See Fig. 129.)

The patient, having a wet napkin or a soft towel pinned over his head, is laid upon the sheet, so that its upper border touches the nucha. The attendant now rapidly envelops him in the sheet, taking care that no two surfaces remain uncovered in approximation, and that he does

Fig. 130.

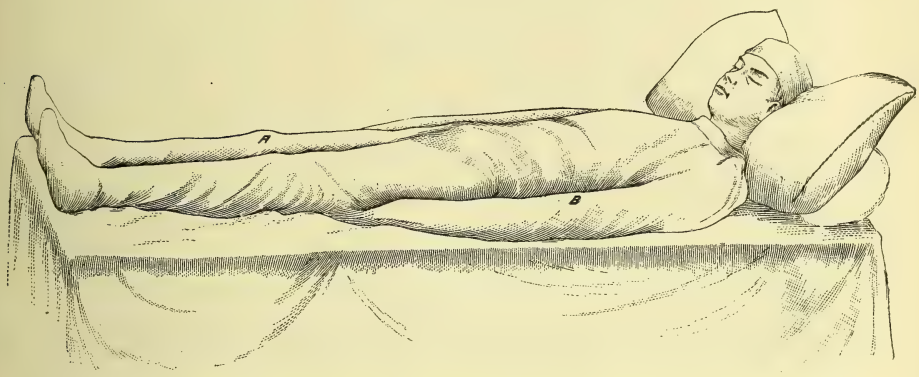


Wet Pack—First Stage. *A*, Damp Sheet. *B*, Being pressed between the right arm and body.

not sacrifice comfort to neatness. Fig. 130 shows the sheet lying over the right side of the patient's body, its edge upon the chest and abdomen, while the attendant presses some folds down between the arm and body.

Fig. 131 shows the sheet folded over the entire body, the folds being pressed between the arms and body and between the lower extremities.

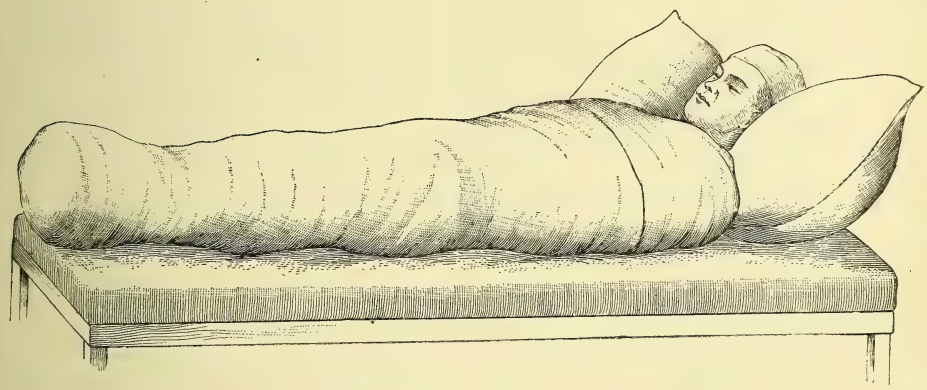
Fig. 131.



Wet Pack—Second Stage. *A*, Damp sheet between legs. *B*, Sheet folded between body and left arm.

The sheet thus having been snugly applied, and secured at the neck, with care not to embarrass respiration, and below the feet, the patient

Fig. 132.



Wet Pack complete on Cot.

is completely covered by the blanket in the same snug manner. Figs. 132 and 133 show the pack complete.

This is called the full wet pack, which may be modified by including only the trunk of the body—trunk packs—or its upper part alone. The length of time in which the patient should remain in it is from half an hour to an hour. If given for the *antipyretic effect*, the sheet should not be so thoroughly wrung out as if for the vapor-bath, and the pack should be changed every ten minutes until the necessary result is achieved or the first signs of deficient reactive power ensue.

The object of the wet pack in chronic diseases differs, as will be

shown, from that aimed at in acute pyrexiæ, hence the modification in technique referred to. It is always advisable to open a window while the patient is in the pack, closing it before he is unwrapped.

The use of the wet pack depends upon the following facts: The

Fig. 133.



Wet Pack on Bed. *A*, Wet towel on head.

difference of temperature between that of the body and of the damp sheet produces the effect of a sudden shock to the peripheral sensory nerve-endings. The result, as has been previously indicated, is a contraction of the cutaneous vessels and the driving of blood from them into the underlying vascular area, chiefly the muscular twigs. This stage lasts, however, only a short time, according to the age and vigor of the patient, his sensitiveness, and his power of reaction. A chill rarely occurs a few minutes after the wrapping, especially if a glass of cold water be given him, and the current of blood sets in again toward the periphery, whose vessels now begin to dilate. The sheet becomes warmer by the more rapid flow of blood to the periphery, from which heat can be but slowly given off, owing to the bad conducting media with which it is surrounded. Finally, perspiration may occur.

The pulse, which on the immediate contact of the body with the sheet, is accelerated for a brief time, becomes more slow, diminishing often from ten to twenty beats, and rising again toward the termination of the pack, when the body is thoroughly warmed. Max Schueller's experiments on animals, referred to on page 465, show that the vessels of the pia mater become dilated in the cold pack, but contracted after the surface becomes warm. The respiration is somewhat accelerated. The fact that the blood then circulates more slowly through the lungs, although the latter act more rapidly, would point to an increased oxygenation of the blood in the wet pack. The body being practically enveloped in a vapor of its own creation, the skin gives off a good deal of moisture, and with it other matters, if Quirolo's investigations on the elimination of noxious materials through the perspiration in infectious fevers be correct. If the pack is prolonged to several

hours, so long as the sheet retains a temperature below that of the body the continuous flow of warm blood to the periphery excites cutaneous-nerve stimulation, and the process of in- and outflow are repeated, the vessels being subjected to a discipline which is invaluable in some affections, as will be shown.

If the pack cannot be prolonged in chlorotic or weak individuals, who possess feeble heat-productive power, if chilliness becomes pronounced, and warmth does not succeed it or is followed by chilliness, the wrappings should be removed. Such individuals may have their reactive capacity assisted by active friction or other heating procedures prior to entering the pack. It is an error, however, for that reason to raise the temperature of the water in which the sheet is dipped. *It is a law in hydrotherapy that the nerve-stimulus (hence the reactive power) is enhanced by the intensity and brevity of the application.* A sheet wrung from water at a temperature of 60° in a patient who has been previously warmed up (not by active exercise, however) will bring on reaction much sooner than one wrung out of water at 80°. A coarse sheet, well wrung out, is here indicated.

The wet pack calls out all those physiological effects which have been referred to in the first part of this essay—viz. a heightened functional activity in the nervous and muscular systems, and consequent enhancement of the processes contributing to nutrition and tissue-change. In addition to these, the quiescence which follows the commotion induced by the first stimulus of contact, and the subsequent equalization of temperature between the body and the surrounding media, furnish an important therapeutic agent. Probably, through removal of the acid fatigue-products, this passive state of the nerve-centres is enhanced; hence many sleep in the pack, an evidence of its calming effect. This reduction of functional nerve-activity in the muscular and nerve-tissues prepares them for recuperative processes, since, according to Ranke, these structures receive nutritive elements chiefly if not entirely during a state of comparative inactivity.

The enforced rest for one or two hours produces a favorable influence also upon the hyperæsthetic condition of some neurasthenic and hysterical cases—a discipline which may be rendered therapeutically valuable by judicious modifications adapting it to each particular case.

The Wet Pack as an Antifebrile Agent is here separately considered, because its technique is quite distinct from that just described, which is chiefly used in chronic affections. In febrile diseases we have no remedy that will refresh the patient more than this, and render him comfortable. If the temperature is high, say 103° or higher, the sheet is wrung not entirely dry out of water from 75° to 60°. The patient is wrapped precisely as in the method just described, except that the blanket may be lighter and no additional bed-clothing

be heaped upon it. So soon as the enveloping sheet feels warm upon the chest, another blanket and sheet wrung out of water of from two to five degrees higher temperature are prepared on the opposite side of the same bed or upon another near the first. The patient is wrapped within these, and again removed into a third as soon as he warms up the second. This is continued about every ten minutes until from five to eight packs have been given or the sheet ceases to warm up rapidly. A prolonged *chilliness is a positive signal for cessation* of the pack. The true antipyretic effect of the wet pack has been carefully studied by Liebermeister, who declares that five packs of ten minutes' duration are needed to produce the same antipyretic result as one full bath at 65° F.

This method presents a mild form of hydriatic antipyresis, which may not be objected to by the patient and friends as much as the full bath. It becomes, therefore, an important measure which may be utilized as a preliminary to introduce more heroic treatment.

All wet packs must be succeeded by some procedure which checks the relaxation of the cutaneous vessels and restores their tone. This is a rule which the scientific as well as the empirical hydrotherapists insist upon. After the process of packing is finished, then in chronic diseases, when the patient is fairly strong and able to move around, his feet are freed from the blanket and also loosened somewhat and encased in slippers. He now walks or is carried to a tub half full of water at from 70° to 60°. The blanket and sheet are rapidly removed by the attendant, and the patient bathes his face and chest in the water and seats himself in the tub. The attendant now dashes the water upon his back and shoulders by means of a little pail or basin, while he does the same with his hand upon the chest and abdomen and practises friction upon his extremities. After from three to eight minutes he is removed and thoroughly dried.

In febrile cases or in cases of debility a simple ablution with water at 50°, followed by friction or a sheet or towel bath, which will be presently described, may terminate the packing. This is a repetition of the stimulation of the cutaneous vessels, their contraction and subsequent dilatation, and the ebb and flow of blood from and to the periphery. In chronic cases this *finale* is an additional stimulus to tissue-change or to absorption of pathological products; in acute diseases the antifebrile effect is heightened by this half bath or by the cold ablution.

As a discipline for the nervo-vascular and glandular apparatus of the skin it is the most useful method. The so-called hardening effect is marked as a protection against colds and catarrh, and the restored tone of the cutaneous nerves offers an important adjunct in the management of depreciated neurotic patients. Usually the appetite improves

strikingly, sleep is promoted, and general robustness results after a longer or shorter continuance of this method.

Partial Packs in the form of damp compresses may be used over inflamed or hyperæmic parts. These are well known in the treatment of asthma, of pulmonary troubles, of congestion of the abdominal viscera and glands, or in other hyperæmias. In all but the last two cases they are applied as stimuli to the superficial vessels lying over the inflamed parts. If the cloths are well wrung out of water at from 60° to 50°, the first impression of cold passes rapidly away, and is followed by a pleasant warmth due to the superficial hyperæmia. These compresses should lie upon the parts snugly, and be covered with flannel to retard evaporation and escape of heat until they are nearly dry. They should be renewed after the part has been rapidly bathed with cold water, and repeated as often as necessary. We possess no more soothing, calming, and derivative absorbent agent. In superficial inflammatory affections the linen compress should be thinner, not wrung out so completely, and not covered, and be more frequently repeated. When the object is to reduce local hyperæmia, a better plan is to lay single strips of linen upon blocks of ice and apply them frequently to the inflamed part. In purulent conjunctivitis, for instance, in threatening phlegmon, in contusions, sprains, and cutaneous inflammations, this method of applying cold has been found eminently useful. It should be observed, however, that if reaction is allowed to follow each application of the iced cloth, its object would be defeated—*i. e.* the constringing effect. Hence frequent continuous repetition is a *sine quâ non* in this instance, while in other cases the pack or compress must be prolonged until it is nearly dry, to obtain the superficial relaxing effect from the vapor-bath produced by it prior to the application of the terminal cold.

The Abdominal Compress is one of the most valuable of the local packs. It is made by forming several folds of a coarse linen towel of sufficient breadth to reach from the ensiform cartilage to the pubis, one of which is then wrung out of cold water. After this is applied the remainder is rolled around the body so as to retain snugly the position of the first, or four folds of coarse linen wrung out of cold water are applied and secured by a flannel bandage.

The Therapeutic Indications for the Wet Pack may be found in most subacute or chronic diseases involving faulty tissue-metabolism and consequent or coincident deposit and afflux of pathological products to parts.

In chronic articular rheumatism, especially if accompanied by anæmic manifestations, in muscular rheumatism, gout with or without deposits, in catarrh of the gastric or intestinal tract, the indications for the wet pack of an hour's duration, followed by a rapid cooling pro-

cedure, will be plain to the reader who has carefully studied its *modus operandi*. In the above-mentioned affections many positive curative changes have been attributable to this procedure, in the observation of the writer, after his failure with all the most approved medicinal and non-medicinal remedies. Precise rules for the management of such cases cannot be laid down in this brief article, nor are they necessary if the *modus operandi* is understood.

In cases of anæmia undoubted effects in the improvement of the condition of the blood, as evidenced by the general aspect of the patient and from hæmometric observations, have been recorded by the author, as well as by many writers on the subject.

In phthisis, when the heart is irritable or excitable, there is no more powerfully calming measure than wet packs of the whole body until it is moderately warm again—that is, from one-half to three-quarters of an hour—followed by a rapid cool rain-bath. Professor Winternitz speaks highly of chest compresses, prepared with napkins folded in a triangle, which after being well wrung out of cold water are applied so that the apex of the triangle lies over the ensiform cartilage, while the other corners are respectively folded over the shoulders; or it may, in the event of the posterior portions of the lung being involved, be placed over the back. Or a wide roller of linen may be wrung out of water and applied in a figure-of-eight over the entire chest. All these must be covered by flannels.

Winternitz claims that the vapor from the damp cloth and the uniform heat evolved from it produce a condition favoring organic processes. He regards the constantly enveloping gentle warmth as acting beneficially in evolving reactive inflammation, limitation, separation, absorption, or cure of diseased tissues.

In hæmoptysis the application of cold compresses frequently repeated upon the front of the chest is useful, because they deepen respiration, thus preventing stasis, and act as local soothing measures.

In acute croupous and catarrhal pneumonia the local chest-pack is an invaluable measure. A linen compress, three- or fourfold, should be applied with care, well wrung out of water at 50°, and covered by a flannel or stout cotton bandage to prevent dampening of the patient's clothing. The latter would seriously defeat the object, as any experienced nurse knows. Care in applying it without too much disturbance of the patient is important. The compress should be changed every half hour if the temperature be high. Besides his own clinical experience, the author may cite so good a teacher as Felix von Niemeyer,[1] who says: "It has been of great interest to me that both Bartels and Ziemssen strongly commend the application of cold com-

[1] *Textbook of Practical Medicine*, translated by Drs. Humphreys and Hackley, D. S. Appleton & Co., 1875, p. 195.

presses to the chest, as proposed by me in croupous pneumonia, as by far the most efficient treatment."

When the temperature is high and the pulse and respiration are very rapid in the early stages of pneumonia of children, the full wet pack is indicated. Its soothing effect is marvellous. That it requires some courage on the part of the uninitiated to wrap a child with pneumonia in a sheet wrung out of water at 65° a recent experience of the writer illustrates. While in the act of doing so the anxious father expressed his feelings by saying to me: "Doctor, this seems like heroic treatment, but we trust you." My reply was emphatic when five minutes later I pointed to the child which had been tossing in great distress all night, and who was now slumbering peacefully, its cyanosed features having become calm.

In all febrile conditions from whatever cause, especially when high temperature with enfeebled circulation is present, wet packs are calmative, not only reducing temperature, but soothing nerve-erethism and aiding in the diminution of effete material by stimulating the heart and encouraging diaphoresis and diuresis. The medicinal antipyretics do not fulfil so many indications, but owing to the greater simplicity of their administration may be preferred in all non-infectious fevers.

Strümpell, whose work, translated by Shattuck of Harvard University, is now a textbook in our best colleges, says (page 173): "In the treatment of lobular pneumonia of children the best remedies are tepid baths with affusions and general wet packs applied several times a day. The higher the fever is, the oftener must these be repeated; with moderate fever the child may stay in the pack for two or three hours."

Drs. J. Kaufman and Baer[1] give some exact investigations made in Kussmaul's clinic on wet packs and compresses in pneumonia. The temperature of the water was from 59° to 68°, and the patients were entirely enveloped for half an hour—longer if they felt comfortable; which is the custom in Kussmaul's clinic in cases of the exanthemata. Almost without exception the patients felt pleasantly during the cooling, and much relieved afterward; dyspnœa was diminished, and often the most restless patients were calmed into slumber. Although the temperature was not much reduced, the object achieved was a powerful derivative to the skin with all its beneficial results. In most cases the blood-pressure was increased at first, but quickly considerably reduced, as measured by Busch's instrument, while the pulse was reduced in some cases and not in others.

In cases of acute nephritis, in which Kussmaul had often seen in his consultation practice serious dyspnœa with bad, even lethal, results from hot baths, the cold wet pack acted far differently. The subjective

[1] *Berlin. klin. Wochenschrift*, July 9, 1888.

condition of the patient was greatly improved, an energetic derivative to the skin was instituted, and if the patient was afterward covered with a blanket energetic perspiration ensued. The blood-pressure was regularly diminished by the packs, and returned very late to its original height.

In cholera infantum and summer diarrhœa, when decided pyrexia is present, the abdominal wet compress is far superior to poultices, which are so much in vogue, because they dilate the cutaneous vessels quite as much by the reaction they induce, and thus promote any probable derivative effect, while they are equally soothing and aid in reducing elevated temperatures.

The Hot Wet Pack.—In this connection a method may be referred to which, though it has a limited application, is invaluable. Instead of wringing the linen sheet out of cold water, it is dipped into water at 110°, well wrung out and spread upon the blanket, as in the cold pack. The patient is wrapped as in the latter, and allowed to remain for an hour. He is now rapidly removed to the side of the bed upon which he is to lie, lightly rubbed over with a rough wash-rag squeezed out by the hand, dipped into water at 65°, quickly dried, and left alone.

This method in the author's practice has been found useful only in obstinate insomnia. Its effects are explicable upon the evidence of Max Schueller's experiments on rabbits.

The Hot Blanket Pack is a procedure that has long been utilized by physicians not otherwise familiar with hydrotherapy. It is prepared by placing a rubber sheet and one or two woollen blankets upon the bed. A heavy woolen blanket is now wrung out of water at 110° by two persons twisting it in opposite directions. This is spread upon the dry blanket and rubber sheet, the patient placed upon it and wrapped with it like a mummy. The dry blankets and rubber sheet are now wrapped over the damp blankets, and the patient is allowed to remain in this pack from half an hour to two hours. By this means the superficial vessels are at once dilated, and continue so under the influence of the artificial vapor. The functional activity of the skin is increased, perspiration ensues, and peccant matters are eliminated. The superficial hyperæmia acts as a general poultice and as a derivative from the viscera. Tension of the blood-vessels is decreased and a general relaxation ensues.

The Therapeutic Indications for the Hot Blanket Pack are numerous. In suppression of urine the writer has obtained marked effects from this pack. In cases of uræmia it is a resource which should not be omitted, and this fact is testified to by numerous clinical records. The most recent of these is that of B. C. Hirst,[1] who records two very

[1] *University Medical Magazine*, July, 1890.

severe cases of eclampsia during and after labor at the Maternity Hospital in Philadelphia, which, apparently beyond hope, yielded in an astonishing manner to the profuse diaphoresis following a hot wet blanket pack after other remedies, including venesection, had accomplished nothing.

Local Hot Packs.—These are prepared by wrapping the patient in a dry blanket, and applying old pieces of blanket of sufficient size well wrung out of water at as near the boiling-point as possible. The latter is done by using a clothes-wringer or a piece of stout canvas half a yard square, to two of the sides of which handles are secured projecting beyond the upper and lower edges. The hot, wet pieces of cloth are laid upon this wringer, which is now twisted in opposite directions by its handles. Care should be taken that every particle of unabsorbed water be squeezed out, for only by this means may scalding of the parts be avoided. If they are well wrung out, the attendant may handle them with impunity: he applies them to painful parts by raising the enveloping blanket, and again secures the latter snugly. Thus a constant hot vapor is created under the blanket, which produces profuse diaphoresis; the direct heat from the wet cloth produces hyperæmia over the affected parts, and thus relieves local pains. These applications are frequently renewed for from half an hour to an hour, until the patient is in a profuse perspiration. He is now quickly dried; receives a rapid ablution with water at 65°, is dried, and placed on the side of the bed he is to occupy.

The therapeutic indications for this method explain themselves. Its chief application is in rheumatic and neuralgic affections. In recent lumbago and sciatica I value these applications above all other external or internal remedies. They require skill on the part of the attendant. I have seen one bad case of scald produced by imperfect wringing.

The Dripping Sheet.—This is a perfectly distinct procedure from the wet pack, and, as it is frequently confused with the latter, its description follows most usefully at this point.

My experience having been originally with the greatly depreciated patients at the Montefiore Home, I devised a method which I have retained in more robust cases. To avoid the chilling effect of cold water upon the feet, the patient is placed erect in a tub containing twelve inches of water at 100°. A linen sheet, the coarser the better, is now dipped in water at 70°, which is reduced daily two degrees until 48° is reached. This is thrown over the patient from behind, covering the head and body, so that it clings to the latter (Fig. 134). The attendant now makes rapid passes with both hands, beginning anteriorly and posteriorly, so as to produce friction and afflux of blood to the surface, increasing the surface irritation by occasional gentle tapping and slapping with the outstretched hands. When parts of the body feel warm

to the attendant's hands, cold water at from 40° to 70° is thrown upon them from a basin or cup and friction is renewed.

Another method is executed by wrapping the sheet from the front, around the patient's body alone, while he stands with outstretched arms. Placing the left upper corner under the patient's right axilla, he secures the left edge by holding it with the arms against the body, while the attendant carries the right edge under the left axilla, the patient now replacing this arm alongside the body, and then, carrying it over the back, throws it across the right shoulder, and thence around the neck and upper chest to the left, where it is tucked under. The patient's arms being uncovered, he aids in the friction in front.

Fig. 134.



Dripping Sheet.

Great care should be taken in feeble patients to make the friction mild, in high states of pyrexia to use a finer sheet and more and colder water, and in chronic cases to use a coarser sheet and less water and more active friction. It must always be borne in mind that it will make less demand upon the patient's vitality to apply a sheet wet with water at 60° than at 95°. By shortening the duration and producing friction, reaction will be favored when the lower temperature is used. After the dripping sheet the patient should be rapidly dried, and if able should be sent into the open air; if not, he should be well covered and the windows opened, in order to obtain the full advantage of the deeper inspiration.

The *rationale* of the dripping sheet is explicable upon the general principles above referred to. The sudden cold impression upon the entire body stimulates the peripheral nerves actively. This stimulus results in a reflex action. The blood is driven from the superficial vessels, only to return quickly wherever the friction-producing hands dilate them. Hence an active vascular ebb and flow is constantly in operation, which relieves internal hyperæmia, removes vascular tension, relieves the heart if embarrassed, reduces the pulsations, and invigorates its muscular tone. Respiration is greatly deepened from the moment the cold wet sheet strikes the large surface exposed to it. The inspiration being deepened while the blood circulates more slowly through the lungs, oxygenation with all its advantages is enhanced.

Therapeutic Indications.—This most powerfully stimulant procedure, rendered more so by the assistance of the attendant, is useful in anæmia and chlorosis, in which an improvement of the cutaneous circulation is so imperatively demanded, and in which tissue-metamorphosis must be promoted. In all chronic diseases in which the blood-making function is defective the dripping sheet is one of our most valuable resources. In phthisis I have found this the most useful of all procedures when properly adapted to the case, and when the latter has been prepared for it by hydriatic procedures of gradually increasing intensity. It should always be adapted to the patient's reactive capacity; the room should be warm and all the preparations for rapid drying be made before he is subjected to it. There is no advantage in a higher temperature of the water than 70°, because even the most feeble will, if properly prepared, react better if the temperature is lower. The effect may be enhanced by a dry pack preceding it, which accumulates heat upon the surface, and thus precludes the removal of any internal heat from an anæmic patient.

In acute exanthemata, when the temperature is rising and there is evidence of sluggish circulation in the slowness of the eruption, the dripping sheet, with active but gentle friction, will "bring out the rash" by equalizing the circulation, relieving the heart, and deepening the breathing.

In feeble digestion, in chronic catarrh of any organ, in visceral engorgements or infarctions—in short, in all diseases in which a refreshed circulation and innervation may lead to a "renewal of life," as Dr. King Chambers aptly expressed it—the dripping sheet is the procedure *par excellence.*

The Half Bath.—This is prepared in a tub containing about eight or ten inches of water of such temperature as the case in point demands. The pressure of the water is thus avoided, that the attendant may more readily practise douching and friction. A wet towel being tied around his head, the patient is seated in the tub; the bath water is poured and dashed over his back, head, and shoulders with the attendant's right hand, while he practises friction with the left, and the patient does the same on the anterior portion of the body. Occasionally the patient dips his whole body into the water for a minute or two, while the attendant continues the friction. The temperature of the bath water may be lowered if a more decided impression is desired. The bath is continued for from five to twenty minutes, the patient and attendant continuing active friction. By these measures there is a constantly recurring shock and reaction. The lower the temperature in this bath, as in others, and the more brief the cold application, the more active will be the stimulus and reaction. Winternitz regards

the half bath as far more temperature-reducing than even a colder full bath without motion. The active and unimpeded friction operates favorably as a heat-abstractor; heat is given off to the water and chilling is prevented. If coma or delirium is present, this bath produces an awakening effect upon the nerve-centres by permitting of affusions from some height. The duration of the half bath should be from ten to thirty minutes, and the temperature of the water in high fever should be from 60° to 75°, using the higher temperature of water on the lower part of the body, and the lower temperature on the higher portions of the body. If, however, the reaction is likely to be sluggish, the lower temperature is far more useful, if *briefly applied* with good friction and douching. The skin must show some bright redness, not a dark mottled hue. The efficacy and pleasant effect of the half bath depend upon the skill and judgment of physician and attendant.

Winternitz dwells upon the effect of properly-executed half baths upon respiratory difficulties. In pneumonia with exudation, dyspnœa is relieved or cured when the skin has been made hyperæmic by a good half bath with affusions.

The principle of peripheral vascularization referred to in the therapeutics of the full bath is worthy of careful attention in the treatment of the now too-often fatal pneumonia. If the theory is correct—and I have little doubt of it—that the right ventricle may be unloaded, and thus relieved by vascularizing the large cutaneous area, we have in the half bath a powerful agent to counteract heart failure and improve oxygenation of the blood.

In all fevers involving a depreciated nervous system, as manifested by ataxia, delirium, and even coma, the half bath is indicated.

In chronic affections the indications are numerous. The half bath, offering all the advantages of other hydriatic procedures, may be resorted to as one of the changes which impress the patient. In constipation Winternitz recommends buckets of water to be thrown from some height upon the patient's abdomen while he lies in the water. After the bath he is quickly dried and rubbed and ordered to exercise in the open air. In Winternitz's establishment at Kaltenlentgeben, I have seen the half bath used more frequently than any other procedure. He applies it with success in chronic inflammatory conditions of the spinal cord, at a temperature of from 74° to 86° F., the latter when lancinating pains are frequent and intense, of eight to ten minutes' duration, without friction. The body is gently kneaded in the water and the back is simply bathed. When the pains diminish the baths are made cooler and shorter. The anæmic condition due to compression of the vessels by exudation in the diseased parts is relieved by the not too forcible vascular interchange resulting from such a bath. Eulenberg and Charcot having demonstrated reduced tension of the

pulse in ataxic patients, these baths, if cautiously given, serve to counteract these conditions and improve local nutrition.

The Full Bath.—This consists of a tub about two-thirds full of water, the duration and temperature being adapted to the purpose in view. It differs from all other hydriatic procedures by reason of the more prolonged contact of the nude body with a large amount of water. It is well to suspend an inflated air-cushion from the head of the tub for the head to rest upon, and a water-filled cushion may be placed on the bottom of the tub to receive the nates. Thus the patient's body may be entirely covered by water, so that his chin just clears it.

The Brand Bath.—In acute diseases, in which this bath is usually applied, and in which the patient demands the utmost freedom from physical and psychical disturbance, a screen should be placed between the bed and the tub to prevent him from witnessing the preparations. The tub should be on rollers, so that it may be filled in or near the bath-room and thence conveyed to the bedside.

While the patient is in the bath a blanket should be spread upon his bed, and upon this a soft linen sheet and a towel under the head-piece. Hot bottles or bricks, wrapped in stockings or pieces of blanket, should be in readiness to warm the feet, which not infrequently remain chilled after a full bath.

Before the patient is placed in a cold full bath a stimulant ($\frac{1}{2}$ ounce to 2 ounces of brandy) may be administered. The sexual organs are lightly covered by a napkin, the face and chest are laved with ice-water, after which he is gently placed in the water. The shock of the cold submersion may cause the patient to declare that he cannot breathe, or it may produce trembling. Usually, if the temperature is below 70°, he will remonstrate with the attendants that he is very cold and that he cannot bear it, but patience and avoidance of flurry or excitement, firmness in insisting that no harm shall befall him, and extreme gentleness, will overcome his objections.

It would be well to avoid sympathetic bystanders, who will by the expression of their faces or by actual remonstrance defeat the proper execution of the procedure. The latter requires the courage of conviction derived from actual practice or careful investigation, so great is the temptation to obey the importunities of the patient and his friends. After the patient is submerged one or two persons should gently pass the flattened outstretched hands over successive parts of the body. By these frictions, as Ernst Brand of Stettin, the originator, has shown, the superficial cutaneous vessels are dilated, and because of the reaction induced by it the skin, which was of a dead white when the patient entered the bath, becomes of a ruddy hue under the hands. It may become cyanotic if friction does not actively counteract the contraction of the arterioles produced by the cold impact. The patient must not

be removed until the allotted time has expired. The best guide to the safety of the bath is the patient's condition. If he complains of being chilly or shivers, he must not be removed until chattering of the teeth confirms the statement. Cyanosis of the lips or face is an immediate signal for removing the patient to his blanket. Many physicians are deterred from continuing the baths sufficiently long (fifteen minutes, according to Brand) when the pulse becomes small and thready. But this is due to the local effect of the cold upon the radial arteries. *Unless the thready pulse is accompanied by an increased number of beats, danger from collapse is not present.* Frictions over the body and limbs should never cease during the bath.

When fifteen minutes have expired, or the patient's condition demands it, he must be gently lifted by two persons, and be held suspended for a minute over the tub while the superfluous water drains off and the napkin is removed. He is now laid upon the sheet, and quickly wrapped from head to foot. If the temperature has been above 103° F., he is covered with the blanket and dried in five minutes; if below 103° F., he is dried with the sheet and towels, his gown replaced, and he is covered by the bed-clothes, hot water being applied to the extremities. At this point nourishment is most readily administered.

The Graduated Full Bath.—This method was introduced by Von Ziemssen, the editor of the celebrated *Cyclopædia of Medicine*, as a modification of the Brand bath. It is better adapted, he claims, for private practice when patients object to the sudden entrance into cold water.

Preparations are made as in the bath just described, except that the tub is filled sufficiently to cover two-thirds of the recumbent body. The water being warm, no shock ensues. The continuous dashing of water upon the body by the attendants, and the gradual lowering of its temperature by the addition of cold water (ice-water may be used if a rapid change is desired) while warm water is being removed, constitute the difference between these baths. Friction is practised, as in the Brand bath. As the graduated bath lasts half an hour, and the water is reduced to 68° as rapidly as possible, the patient really lies quite as long in cold water as in the Brand bath.

The mode of action of the full cold bath is explicable upon the general principles laid down. The thermal stimulus is intense, there being a difference between the temperature of the body and the water of from thirty to forty degrees. The active cutaneous circulation in the early stages of fever protects the patient against injurious effects. If the submersion is brief or if muscular action during submersion could be maintained, as it is after Turkish baths, no harm can ensue. But in fever cases the lack of tone in the vessel-walls seriously impairs reactive

power. Hence frictions are of the utmost importance. Without them much harm may be done, and to their neglect is ascribable much of the prejudice existing against the cold bath in fevers. I well remember a case at one of our large hospitals in which the temperature was reduced from 106° to 100° by wrapping the patient in a sheet and saturating the latter with ice-water squeezed from a carriage sponge. That the patient succumbed (with a lower temperature) is explicable upon the physiological effect of *such* a procedure. The blood, driven from the contracted peripheral vessels to the interior, was not permitted to return to the surface. Hence the cooling was only a surface cooling, ascertainable in the mouth. As the rectum shows one or two degrees higher in many cases, because the mouth is more superficially situated, so may the rectum temperature be depressed still lower by such positive cooling without indicating a lowered temperature in the deeper tissues. How much more rational is the Brand bath, which by continuous chafing of the surface stimulates the cutaneous vessels to dilate, filling them with blood, as is indicated by the suffused redness seen under the chafing hand! The blood is cooled in these dilated vessels, and rapidly carried into the interior to be exchanged for hot blood coming from within. This interchange produces a cooling of less intensity than the continuous chilling of the surface in the bath without friction, but it is more positive and enduring.

Aside from this palpable effect, we have the authority of Leyden, Traube, and others that the rise of temperature in fever is in part due to diminution of heat-dissipation from the surface because of partial paralysis of the arterial coats. Friction, as Weyrich has proved, increases water-elimination, and it, together with the stimulus of cold, overcomes the paresis, and thus increases heat-dissipation. The nerve-centres receive not only the refreshing impressions from the surface, but they are directly supplied with cooled blood, and thus their functions are approximated more to the normal, and the organs depending upon them are favorably influenced. The rapid pulse, indicating that the heart is struggling to overcome the effect of enfeebled innervation, is reduced. The heart, which has been laboring to compensate for the loss of assistance from the contractility of the arterial coats, which Marey and Winternitz have shown to be in abeyance in infectious fevers and to be the chief cause of heart failure, is relieved, because the superficial arterioles are stimulated to alternating dilatation and contraction by the chafing and subsequent impact of cold water.

Thus, all the indications in the treatment of fever are fulfilled: the temperature is reduced, the nerve-centres stimulated and refreshed, and the integrity of the organic functions maintained.

In chronic diseases the cold bath is utilized as a plunge after heat-elevating procedures, combined or not with swimming exercise; and so

we have the mechanical action of the volume of water and the increased pressure upon the peripheral vessels, which must increase the pressure within and improve the force of the heart. Reaction is increased by this active disturbance of circulatory conditions: there is increased tissue-change and the temperature is elevated. If it is continued too long without muscular movements or friction in a patient not having an elevated temperature, the lips and skin become cyanosed, the face and extremities become pallid, cramps and chills ensue, and serious consequences may result, which an active muscular movement would prevent.

The shock from the thermic contact in the plunge is somewhat similar to that of the douche.

The therapeutic indications of the cold full bath must be considered separately, because this bath has a distinct history which is as remarkable as it is unappreciated.

Typhoid Fever.—Without entering into details, it may be stated that to Ernst Brand we are indebted for an earnest, intelligent, and courageous effort to introduce to the profession this treatment, which had since the day of Hippocrates passed through many vicissitudes, again and again appearing under the ægis of some noted men, like Hahn, Boerhaave, Hufeland, Currie, and others. It is nearly thirty years since Brand, unknown at that time outside of his private *clientèle* at Stettin, published his work on the *Hydrotherapie des Typhus.*

In order to exhibit the true claims of this method, and render it more clearly appreciated, I cannot urge too energetically the fallacy of regarding a high temperature as the chief danger in typhoid fever. Until this fallacy is laid away among the rubbish of pathology, fever treatment will continue to be unsuccessful. Let me not be understood as espousing the idea that the elevation of temperature is of no consequence, or to claim that it is a conservative process. Far be it from me to utter such absurdities. The elevated temperature is but one symptom; it is not in itself a dangerous one. This is evident from the enormous rise of temperature physicians in the South so often observe in malarial fevers without evil results, from the same comparative innocuousness of excessive temperature in recurrent fever, and in the aseptic fever so ably described by the lamented Volkmann and other surgeons. Professor Welch has shown that animals may be kept at high febrile temperatures for three weeks without manifesting serious symptoms. The respiration and pulse were quickened, but the arterial tension remained unchanged. The real dangers in typhoid fever are due to the effect of the toxic agents circulating in the blood, plus the high temperature, and not the latter alone. Were the high temperature the chief element, we would find a specific therapeusis in the powerful antipyretics, whose action is as reliable as is that of veratrum viride

on the pulse. The idea that inflammatory diseases could be effectively throttled by venesection or by the pulse-reducing veratrum was short-lived, because it was based upon the one symptom alone. It may be justly argued that the combating of another symptom—elevated temperature—is equally fallacious. Those who practised venesection knew well what comfort it afforded: the throbbing head, the insatiable thirst, the wild raving, ceased as if by magic. The urine began to flow, the skin and mouth became moist, the patient was calmed into gentle slumber. Lulled into a false security, the life-blood was again and again drained away at a time when its integrity was most essential to the maintenance of the vital powers. What wonder then that an enlightened pathology swept this but too-enduring therapeutic octopus from the field and trampled it into everlasting obloquy?

Shall antipyretics (in typhoid fever) fare better? True, their immediate effects upon the economy are not so disastrous. They, too, render the patient comfortable—they too relieve the throbbing brain, moisten the tongue and skin, and quiet the patient. But they too destroy the living protoplasm by chemical action. They dry up, as Vinay has shown,[1] the fountain whence most of the products of retrograde metamorphosis must issue from the system; they enfeeble the heart and nerve-centres; they destroy the hæmoglobin, as Lepine, Semmola, and Stokvis testified in the Paris Congress of Therapeutics of 1888. Thus they damage those vital processes whose maintenance in vigorous function is really the chief aim of all therapeutic endeavor in typhoid fever.

The chief danger lies in the facility with which they may be administered and the rapid yet positive results which ensue. These are temptations to which the inexperienced physician is exposed, and which he will find it difficult to resist unless he be informed by the investigations and clinical observations of others. The systematic use of antipyretics is therefore as objectionable in typhoid fever as are all other spoliative measures. The chief aim of treatment is to sustain the vital powers until the disease has run its course.

The chief agent in the management of typhoid fever is the cold bath. Practical observations in thousands of well-recorded cases have demonstrated that the systematic application of cold baths has reduced the mortality from typhoid fever to a point below which it will probably never fall. A treatment which shows 1 per cent. mortality in 1223 cases collated from five different sources, including private practice and civil and military hospitals, may be regarded as nearly perfect.

In several papers read before and freely discussed in our medical societies I have endeavored to impress upon my colleagues the true import of the results achieved in Germany and France by the cold-

[1] *Lyon Médical*, 1888.

bath treatment of this disease. Statistics are proverbially misleading when marshalled to sustain a special plea. They may be readily distorted, even by one whose object it is to present them fairly and judicially. In a question of such enormous import as the saving of a human life and the lessening of human suffering it would be criminal to endeavor to sustain preconceived notions by claptrap arguments or fallacious statistics. I have therefore approached this question imbued with the solemnity and import of the issues involved.

Moreover, let it be remembered that I am not advocating the cause of a bantling of my own creation—that I am not striving to achieve fame by the dissemination of my own discovery. As a member of a profession whose highest aims have ever been not only to relieve their fellow-men by direct ministration, but to impart knowledge obtained in the pursuit of the latter, it is my sole purpose to fulfil these aims.

Therapeutic deductions must be based upon theoretical considerations and clinical results. The hydrotherapeutic management of typhoid fever rests on both. In this disease we have an infectious process whose presence is accepted almost universally, although its origin and concomitants are still *sub judice*. Whether it be a process due to the presence of micro-organisms, whose multiplication in the system produces the fever, or a conservative agency by which the disease-germs are to be destroyed and eliminated; whether the local process be the cause or the result of the infection, the latter is manifested by a group of symptoms which unmistakably point to its presence. We have an elevated temperature of characteristic course, accompanied by increased heart-action, with a tendency to feebleness; more or less depression of the nervous system, evidenced by debility, headache, delirium, and impaired digestion, with marked absence of hydrochloric-acid secretion; the skin and kidneys too are crippled in their important eliminating office. That the impairment of all those organs, upon whose functions the maintenance of life depends, may be traced to the toxic agency acting upon the nerve-centres, is pretty clearly demonstrated. We have no more positive evidence of the fact than that presented by the clinical observation that in the treatment of this disease, in which many changes have been made, those methods have been most effective which have aimed to maintain the action of the nervous system in the most vigorous condition. The so-called stimulating and supporting treatment has survived all other methods, because it aims to maintain the integrity of the nervous system, upon which all the vital functions of the body depend. The cold bath has again and again been demonstrated as the most effective stimulant to the nervous system. When a woman faints we have a complete picture of nervous depression affecting the circulation, respiration, and probably all other functions. Is not a dash of cold water

our chief remedy? Is there any medicinal remedy equal to it for arousing the nerve-centres? The first impression results in a deep inspiration; a fresh supply of oxygen is furnished to the blood, which once more courses through its wonted channels, bringing color to the pallid cheek, restoring fire to the glassy eye, and consciousness to the stricken brain.

Trite and simple as this remedy seems, it offers us most convincing proof of the stimulating influence of water upon the nerve-centres. In typhoid fever we have it upon authority which we dare not question that the cold bath refreshes the nervous system; that it deepens the respiration; that it moistens and cleans the tongue, improves the appetite; that it steadies and slows the pulse; that it improves the digestion; that it increases the quantity and improves the quality of the urine; that it removes stupor and delirium. In short, it lends vigor and tone to the entire system, and approximates the condition of the patient so nearly to the normal that his entire aspect is changed. This testimony comes from men like Ziemssen, Bartels, Nothnagel, Hoffman of Leipzig, and other clinical teachers who have cautiously tested and deliberately weighed the results of hydrotherapy at the bedside.

That the cold-bath treatment has survived the onslaughts of prejudice and unpopularity during a period in which so many important developments in medicine have occurred—one of which alone, the discovery of the truly powerful chemical antipyretics, would have sufficed to wreck it—must be conceded as the most convincing test of its clinical value.

The material from which evidence of its surpassing value may be culled is simply enormous. Indeed, no therapeutic question offers so abundant and varied a statistical array of facts. The comparative merit of various methods of treatment is best illustrated by the record of the well-known garrison hospital at Munich, which furnishes us such clear, incontrovertible, bedside observations that it alone may be relied upon to stand as a bulwark of defence against all attacks. Vogl, who is the chief of this military hospital, has been gradually led to the abandonment of all other methods in favor of the strict cold bath by studying the records of his institution for forty-seven years! During this period every known method of treatment had been in vogue in 8325 cases of typhoid fever. The various types of the disease are clearly pictured in his works, as well as its management, from venesection to therapeutic nihilism, with all intermediate methods. As has been the fashion of late, antipyretics and baths have also had their sway.

During the past fifteen years a comparative study of 889 cases shows the results of the bath treatment to be superior to all others, despite the changing types of the disease. The cases not being selected for

either station, the following is the result of the strict bath treatment and a moderate bath treatment combined with antipyretics:

Results.	Strict Bath.	Combined Method.
Mortality	2.7	6.7 per cent.
Average stay in hospital	47.3	40.7 days.
Percentage of complications	68.2	102
Average number of diarrhœas per person per day	0.7	1.9

There is no doubt that these papers of Vogl are the most fair discussion of this question extant. Indeed, it may be justly said that no question in therapeutics has received so complete a survey, inasmuch as we have here a truthful picture of the disease in all its phases, the treatment in all its fashions and forms over nearly half a century, in an institution under constant disciplinary supervision, and among patients of almost the same physical condition, receiving the same diet, and doing the same work. For a comparative estimate of treatment no better data can be imagined. Additional statistics may be offered, but they would only confuse, because they must include old and young, rich and poor, males and females, under varying conditions.

Suffice it to summarize, that while by the combined treatment the average mortality has been reduced to a lower point than ever before—viz. from 40.3 per cent. (1843) to 7.6 per cent.—at times the rate of mortality under this treatment reached almost as high as that of the purely expectant treatment. On the other hand, the systematic Brand treatment—a bath at 65° F. for fifteen minutes every three hours so long as the temperature remains at 103° F.—never allowed the mortality to exceed 4.7 per cent. in the last seven years, and averaged 2.7 per cent. Juergensen reports even a smaller mortality—1 case in 217.

Josias[1] reports 36 cases, of ages from five to forty years, treated with the strict cold bath, with one death in a case which entered on the sixteenth day of a relapse. Dr. J. C. Wilson[2] reports 64 cases treated in the German Hospital at Philadelphia, without a single death,—all by the strict bath of Brand; and Dr. George L. Peabody treated 11 cases by this method in Bellevue Hospital, without a death.

A treatment which in a large number of cases offers us a reduction of mortality to about 3 per cent. in a disease which destroys from 20–40 per cent. of all persons attacked, treated otherwise, demands a trial; and we are guilty of criminal neglect if we permit prejudice, difficulty of execution, or any obstacle to deter us from adopting it. I am convinced that even in the sparsely-settled country districts this treatment may be executed.

If we are not able to obtain a good bath-tub, any large wash-tub may be utilized. The patient is seated in it, half recumbent, with his

[1] *Le Courrier médicale*, Nov. 30, 1889. [2] *Med. News*, Dec. 6, 1890.

feet outside, wrapped in a blanket, while his body is bathed and rubbed as described in the half bath. The following is the practice from which the best results have been obtained: It is of the utmost importance to begin water treatment early, even before the diagnosis is clear. A mild bath can do no possible harm, but is useful in all febrile affections, including pneumonia and the exanthemata. If typhoid fever does not develop, the patient's comfort will at least be enhanced, and his recovery from the less severe form of fever hastened if it does develop. Thus valuable time will be saved. Sponging is inefficient. Ablution is more refreshing; then the half bath, then the graduated bath, and lastly the Brand bath, as described, may follow in succession. Stupor, delirium, and coma always demand the bath if the patient's temperature is below 103°. He is placed in a bath of 95°, and basins of water at 60° are poured over his head and shoulders, until he is aroused or shivers.

The Brand bath treatment and the substitutes and preparatory measures have been described here in detail, because they are applicable to all infectious diseases.

Scarlatina.—In this disease we have the comparative statistics of Dr. Reimer[1] of 3460 cases, treated by various methods, 978 being treated by hydrotherapy. Cold compresses to the head, thorax, and abdomen acted favorably upon the heart, but did not lower the temperature much. Good results were obtained from cold envelopment, combined with affusions of water at 54° to 57° in the empty tub; affusions in a gradually cooled bath were favorable, but sometimes collapse ensued.

The gradually cooled bath did not influence the temperature according to Reimer, and produced general weakness which in some cases was of a threatening character. Such baths had a sedative effect in typhoid fever, but in scarlatina they were pernicious. "The efficiency of full cold baths was undoubted in scarlet fever if they were used methodically and with proper precautions. The patient is plunged into a tub half filled with water at a temperature of from 54° to 57° F. After removing him from the water he must be rubbed briskly and wrapped in a woollen blanket. The temperature frequently drops several degrees; patients are much relieved and desire a repetition. In scarlatina the indications of hydrotherapy vary with the progress of the disease." Reimer regards antipyretic medicaments as attended with danger from collapse.

The testimony of Ziemssen,[2] who quotes Currie's remarkable results by cold affusions in 150 cases, which are equivalent to the sudden and brief dipping of the body into cold water practised by Reimer, is equally favorable. He says: "The most recent times have again proved the high value of hydrotherapy in scarlatina. The energy of

[1] *Archives of Pediatrics*, 1890.

[2] *Pathologie und Therapie des Scharlachs*, 1888.

the water treatment must of course be governed by each case; the earlier the patient comes under treatment, the higher the temperature, and more resisting the organism, the lower should be the temperature of the baths and the affusion. In advanced cases stimulants must precede the use of the graduated cold bath."

Pneumonia.—The therapeutics of this fatal disease have passed through as many vicissitudes as those of typhoid fever. Bloodletting, venesection, and veratrum viride pass before the mind's eye in gaunt and sorrowful procession. Expectancy, too, which rescued us from the foregoing measures, has not even given as good results as in typhoid. Would that another Brand should arise to teach us boldly the use of the bath in this disease! It is true we have already much to encourage us in the writings and statistics of Juergensen, Fismer, Penzoldt, and others. To place these on record here may serve as a nucleus for a future steady advance in the right direction. Dr. A. H. Smith brought before the Tenth International Medical Congress in Berlin the true rationale of the heart-failure which kills in pneumonia, when he not only taught that the right heart is laboring because it is unequal to the extra work, as Juergensen showed twenty years ago, but also that this difficulty may be ameliorated by encouraging and maintaining a dilated condition of the peripheral circulation, and that stimulants alone are utterly inadequate to relieve the heart in pneumonia.

Juergensen recommended very cold baths, preceded by stimulants, and gives some remarkable results. But his heroic treatment has found few imitators. I believe that the *cool full bath*, with friction, meets all the indications, which are to deepen and slow the respiration, reduce the temperature, invigorate the heart, stimulate the nerve-centres, and *dilate the cutaneous vessels* by continuous friction.

I have resorted to baths of 90°, reduced to 80°, with extraordinary success in pneumonia of children and youths, and in adults with temperatures over 103°. The temperature reduction is most marked. I have seen a temperature of 106° reduced to 101° on several occasions, which is impossible under any bath in typhoid fever. The bath is given for from fifteen to twenty minutes in a tub near the bed, as indicated above in typhoid fever, and the patient is rapidly dried. Professor Penzoldt[1] furnishes the following deductions from treating 2200 cases in Erlangen; "If the indication is, besides reducing temperature, to improve the circulation, respiration, and cerebral activity, and to further expectoration, *preference should always be given to a cautious bath treatment.*"

Fismer[2] says that in Basle a reduction of 9.6 per cent. in the mortality of pneumonia has been achieved in 200 cases by the bath treatment.

[1] *Münch. med. Wochensch.*, 1890, No. 36. [2] *Archiv f. klin. Med.*, 1873, p. 445.

In catarrhal pneumonia a more rapid application of colder water—dipping into water at 75°, for instance—would be more effective, as is recommended by Strümpell and others.

In the hyperpyrexia of acute rheumatism Wilson Fox, Medley, Murchison, Sidney Ringer, Charcot, and others have reported reductions of temperature of from five to eight degrees. I reported a case of this kind in the *Transactions of the South Carolina Medical Association* for 1873. Every large joint was enormously swollen; the temperature began to rise rapidly, and had reached 106° when I had the patient gently placed in a tub of cold water and ice applied to the joints. The temperature fell, great relief ensued, and the treatment was continued by means of local cold wet compresses; and after failure of the usual alkaline and other treatment—the salicylates were not then in vogue—hydrotherapy absolutely cured this patient.

The full bath in chronic disease is resorted to by the French and Germans in *piscines*, which are large marble or stone reservoirs with flowing water, which is constantly renewed. They are used as plunges after heat-elevating measures for the purpose of increasing retrograde metamorphosis in scrofula, gout, uric-acid diathesis, polydipsia, and as an *auxiliary* in syphilis. They should not be used on feeble or anæmic persons, in pulmonary or cardiac diseases, nor in affections of the brain and spinal cord.

The Warm Bath.—The uses of this procedure are so different from those of the cold full bath that it demands a separate description.

The technique consists in the simple filling of a tub with water at any temperature near that of the body, say 90° to 106°. The patient lies quietly in it, and obtains the effect of warmth, moisture, and water-pressure. The action of the warm bath upon the body has already been referred to. Its principal uses are soothing or calming to the nervous system, producing sleep and allaying reflex instability when applied for brief periods of time. There is, however, one method of using the warm bath which has been in vogue since Langenbeck devised it in 1855[1] for the treatment of extensive burns and wounds. The continuous warm bath, called by Hebra the permanent bath, is made by suspending a sheet in the tub as a hammock. The patient lies upon this surrounded by water, which is kept in an equable temperature (warm) by a proper arrangement of in- and out-flow. Hebra used it with great success in large burns, ulcers, and pemphigus. In the latter he retained patients in the bath for several months (except when they desired to defecate), not only without detriment, but with success, the affected parts being protected from the air and kept constantly cleansed and soothed. In more recent literature we find the remarkable results obtained by Riess.[2] From practical application during twelve years in

[1] *Deutsche Klinik*, No. 37.

[2] *Berlin. klin. Wochensch.*, 1887, No. 29.

one of the principal Berlin hospitals he derived important results in several hundred cases, comprising paralysis of the lower extremities, paralysis of the bladder and intestines, and in bed-sores, in chronic meningitis, in apoplexy with unilateral contractions, in tetanus, chorea, and sciatica, in dropsies, and in chronic articular and muscular rheumatism. These results would warrant us in applying this bath in any of the above cases when they refused to yield to other treatment.

In *typhoid fever* also Riess reports good results in lowering temperature and diminishing complications. He applies a temperature of 88° F. whenever the body-temperature reaches over 102°, and removes the patient when it is reduced to 100° F. At first the effect is unpleasant, but the patient soon becomes accustomed to this bath. From three to nine hours are required to effect the reduction indicating removal. His clinical charts are very interesting, being examples of one thousand cases. The mortality was 8.5 per cent.; the duration was, singular as it may seem, almost always shortened. All symptoms improved after the first quarter hour, during which time the heart seemed sometimes embarrassed.

This method has a good future. It is certainly less heroic than cold baths, and if properly arranged demands little trouble. When cold baths are objected to, the permanent warm bath offers an excellent substitute.

The Douche.—When water is brought from a height or otherwise issues forth under atmospheric pressure through a tube, in a more or less circumscribed stream, upon localized portions of the body, the application thus made is called a *douche*. This procedure was invented by Pietro Tussignano in 1336. It did not become popular, however, until Priessnitz established his rude mountain-stream douche, which doubtless damaged as many people as it relieved. He gathered a stream of water, falling from a great height, into a wooden gutter about six feet above the head, and allowed it thus to fall upon his patients, who were forced to visit it in all kinds of weather.

The penetrating and inventive genius of Fleury recognized the value of the procedure, and eliminating its disadvantages, constructed it into one of the most useful and powerful nerve-stimuli known to the profession. He systematized its application, and his success in practice brought so many followers that the douche treatment has become a distinctive French method. During a recent European journey I found it almost exclusively used in the numerous hydrotherapeutic establishments in Paris. Duval, Keller, Benis-Barde, and others use it constantly—indeed, almost exclusively. While in Germany the wet pack is the most popular procedure, the douche is not excluded there to the extent that the pack is neglected in France.

The douche is furnished by water delivered under pressure of from

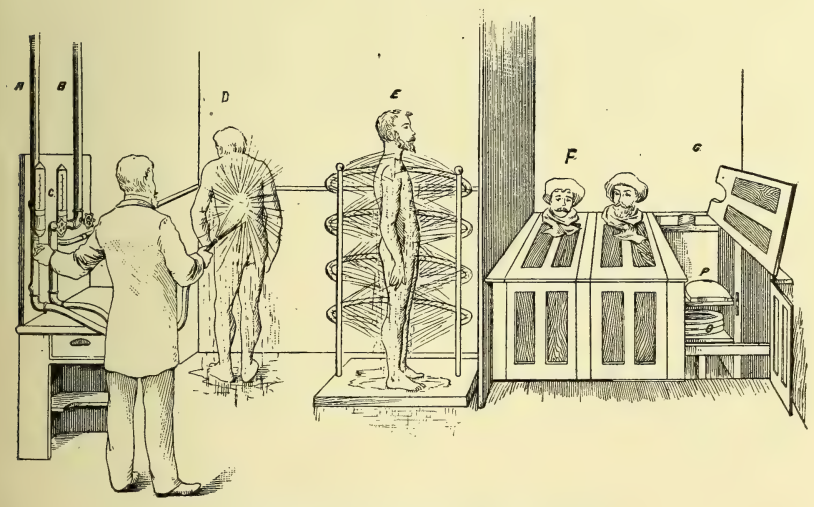
one to three atmospheres, which is equivalent to a fall of from thirty to ninety feet. The most useful arrangement is a fall of about seventy-five feet, with graduated pressures produced by side-outlets or pipes leading from separated reservoirs. It would seem to be more practicable to adapt a compressed-air apparatus to the reservoir, and thus exactly limit the amount of pressure used.

The mode of delivery of the water has furnished certain appellations. The *shower-bath* is one familiar form of the douche. This may be delivered also from a nozzle with numerous perforations which may be attached to a hose, striking the body in a divided stream. Its effect is different from that of the simple douche, called the *jet douche,* which issues from a stationary pipe three feet from the bather or from a nozzle attached to a hose, which is better, and called the *douche mobile.*

The *fan douche* is made by placing a piece of movable copper plate, or simply the finger, over the stream issuing from the nozzle. This spreads the stream like a fan, and when delivered under three or four atmospheres its stings render it difficult to recognize the lowest temperature of the water.

The *rain-bath* consists of from four to six three-fourth circles of pipes secured together at a distance of two to three inches. Each pipe has three lines of fine perforations, from which the stream issues under

FIG. 135.



Author's Douche-room at Montefiore Home.

D, Jet Douche. *E*, Rain-Bath. *F*, Hot-Air Bath. *G*, Hot-Air Bath open, showing *O*, Steam Coil under Seat, *P*.

pressure, striking the body of the patient, standing within it, at all points with considerable force. This is a favorite bath with me at the Montefiore Home as a substitute for the dripping sheet, because large numbers can thus receive treatment rapidly.

Each one of these modifications of the douche requires certain points in the technique which are essential. That *the temperature* of the water must be exact goes without saying. In order to obtain this with precision a thermometer must be secured to the pipes in such a manner that the temperature may be read off before the water is turned upon the patient. The arrangement which is depicted in Fig. 135, which was designed by the writer for the Montefiore Home and has been in use there for several years, explains itself. The pipes are one inch in diameter, nickel-plated, and are connected with the main hot- and cold-water supply. *A* is the hot- and *B* the cold-water pipe. Being connected by *C*, the hot and cold water may be mingled until the requisite degree is indicated on the thermometer, whose bulbs are in contact with the water. As the douche rarely lasts over a few seconds, the change in the temperature of the water during its outflow will not be material.

The *duration of the douche* is a matter of importance. It should always be brief, not exceeding three minutes, usually from ten to seventy-five seconds.

The impression required is evanescent. The douche combines more than any other procedure the pronounced mechanical and thermic elements. Inasmuch as the application is made over various parts of the body successively, it resembles the ablutions or partial baths, but the mechanical effect is more intense. The latter, if combined with a low temperature, produces *hyperæsthesia* of the cutaneous surface, unless it is prolonged beyond one or two seconds, when *anæsthesia* may result. Winternitz found an increase in muscular power, as measured by the dynamometer, and an enhancement of electro-motor excitability, as evinced by the susceptibility to electric influences in paretic muscles only partly obedient to the will. Upon the body-temperature the effect is not pronounced, but upon the blood-pressure, vascular tone, and circulation the effect is the same, only intensified, as other hydriatic procedures.

Therapeutic Indications.—The douche is chiefly applicable in chronic disease demanding a powerful nerve-stimulus. In paræsthesia and paralysis of hysteria, in all conditions of loss of tone in which no organic defect exists in the nerve-centres or their conducting lines, brief douches of water from 60° to 40° are useful. For hysterical convulsions there is one sovereign remedy—cold water, either in a bath or douche, says Strümpell. But as a general tonic the douche is found serviceable in all forms of hysteria in the Montefiore Home.

In anæmia, chlorosis, and other blood-diseases due to disturbed tissue-metamorphosis the douche will prove advantageous for arousing the dormant nutritive energies.

Extraordinary effects are recorded also upon enlargements of the

spleen and liver. Delmas reports actual measurements by Piorry, before and after the douche, applied to the spleen, in evidence of the possibility of moderate reduction of its size by this procedure. In inveterate cases the method should by no means be neglected.

In *chronic inflammatory conditions* on or near the surface the douche may often be resorted to with great advantage, especially in the form of the Scotch douche, which consists of alternate streams of hot and cold water rapidly and briefly applied.

In *chronic rheumatic arthritis* more may be accomplished by this method than by any other local treatment.

In *obstinate neuralgic diseases*, intercostal and trigeminal and articular, the French writers report remarkable results from general douching. Delmas and Duval furnish clinical histories of the most inveterate neuralgias in which, after gradually accustoming the patients to bearing cold water by ablutions, they utilized the douche of one quarter to one minute's duration, of a temperature from 37° to 45° F., promenaded, as they aptly call it, over the entire body, once or twice a day. These histories must be read to be appreciated, that the reader may be imbued with the value of hydrotherapy in these as in other obstinate neuroses.

In this brief *résumé* it must suffice to say that I have had occasion several times to follow the methodical treatment recommended by Duval, with results that border on the marvellous.

In *dyspepsia*, Germain Sée, Ziemssen, and others refer to the importance of douches and other hydrotherapeutic measures. Germain Sée justly claims that, inasmuch as Mosler's vivisected animals showed contraction of the muscular coats of the stomach and intestines, and also diminutions of the spleen, under douches applied to the surface, this method must be useful in atonic states of the muscular and mucous coats of the stomach. Hydrotherapy is called upon to fulfil the most valuable indications in dyspepsia. It stands at the head of the means for combating atrophy of the abdominal muscles, and attacks the root of all troubles of the motor innervation producing dyspepsia. Thermic agents in general, and cold in particular, are powerful modifying agents of motor innervation. After considering the general effects of cold baths, he says it will be necessary to use a cold application of certain duration to the abdomen, made in the intervals of digestion, combined with sedative douches to the vertebral column to diminish morbid excitability of the spinal axis. To stimulate the languishing contractility of the abdominal muscles recourse should be had to rain or fan douches directed on the stomach, or, what is better, to the "Scotch douche."

These douches modify the circulation of the intestinal mucous membrane, the insufficient secretion of the glandular apparatus, the lack of

acidity of gastric juice, and the excessive production of mucus, as well as the general nutrition.

We possess in cold water applied to the skin a powerful means of regulating the action of the heart by augmenting the sum of its useful work.

Peripheral excitation of cutaneous nerves acts reflexly upon the pneumogastric and excites the terminal ends of the splanchnic nerve, causing contraction of the vessels controlled by these nerves. Thus a more active and healthful circulation is produced in the chylopoietic viscera.

For *obesity* we possess in cold douches, properly applied in connection with vapor-baths, as shown by Godlewsky and Anton Frey, a most powerful agent for producing metamorphosis of fatty tissue. The ordinary method of gradually lowering the temperature of the douche, adopted in Turkish and Russian bath establishments, defeats the physiological action above referred to as resulting from intense thermic impressions, and are therefore as absurd as many other hydriatic procedures practised by uneducated people. Unfortunately, physicians do not attach sufficient importance to the absurdity of these Turkish-bath practices, which delude corpulent people into a belief that they are benefited because the scales show a reduction after the bath.

Improved tissue-metabolism, especially the consumption of more nitrogenous tissue-material, results from *pronounced* thermic impressions alone. Hence the douche following the vapor-bath, if it is applied for the purpose of fat-reduction, should be in decided contrast with the temperature of the skin. A temperature not above 70° should be tried the first time for one minute. This should entirely cease for five minutes, to allow the patient to react. Now a douche of 60° may be tried if the pressure is over one atmosphere. Five minutes should again elapse ere the third douche is given, and this should only be given to vigorous people. If full reaction has occurred, the last douche may be given at 50°, or even 40° F. No harm will ensue from the latter temperature if the stream comes in a spray under great pressure, say three atmospheres (ninety feet descent). Having thus ascertained the patient's reactive capacity, a lower temperature may be begun with each vapor-bath. The reported results are very satisfactory. But this treatment should never be undertaken by the lay attendant without medical supervision and cautious adaptation. The highest and lowest contrasting temperatures which the patient is capable of bearing without detriment are the most efficacious in removing an excess of fat. This is a principle established by physiological experiment and corroborated by clinical experience.

To sum up; the *douche* is adapted to the most varied conditions and is capable of fulfilling every function of a hydrotherapeutic procedure. According to its temperature, form, duration, and atmospheric pressure,

we may abstract heat, produce contraction and dilatation of blood-vessels, slow the action of the heart and improve its force, deepen the respiration, send the blood to parts formerly sluggishly vascularized, and draw it from hyperæmic portions, excite nerve-influence of various degrees, produce change in functions, secretion, and tissue-changes. Our French confrères regard the *douche mobile* as the therapeutic arm of the physician, and place it at the head of all other procedures.

The Sitz Bath.—These baths are administered in tubs arranged for this purpose, and made of wood or zinc, so that the patient may sit comfortably in them, while the feet repose outside upon a raised surface and blanket, so that the popliteal spaces are not encroached upon by the edge of the tub. The water should reach the umbilicus. The cold sitz bath (60° to 75° F.) has been frequently the subject of investigation. Heat is abstracted, the respiration is deepened and slowed, and the heart acts more forcibly and slowly under its influence. Weisflug[1] observed a slight rise of temperature from cold sitz baths in the normal conditions, while in fevers no diminution could be noticed. After the bath the pulse became softer and slower and the temperature fell. In fevers each bath was *succeeded* by an increased fall of temperature.

The first effect of a cold sitz bath is a feeling of oppression in the head, sometimes resulting in vertigo; the cerebral and facial vessels are congested; there is dyspnœa, followed by a deeper respiration. The volume of the other parts of the body is increased, as Winternitz has shown with his pletysmograph on the arm. The blood thus brought to the surface must come from the viscera, to which, if the bath is brief, it returns at once; if prolonged, there results a veritable diminution of blood in the abdominal organs. This has been demonstrated by Winternitz, who has also pointed out the fact that the intra-abdominal vessels form a reservoir which receives and gives off blood, perhaps to an even greater extent than the cutaneous vessels. Their capacity for change is a safety-valve for regulating the blood-pressure of the entire body.

Golz's "tapping experiment" demonstrates how the mesenteric vessels of a frog were filled when the blood was driven from the surface. The phenomena produced when the lower part of the human body is placed in a tub of cold water can only be explained by the devascularization of the internal vessels, chiefly those of the abdomen and pelvis.

A reflex excitation of the sympathetic plexus is probably the chief agency in this effect upon the blood-vessels. The axillary temperature is also raised during the first portion of a sitz bath, due to the increased flow of blood to the upper part of the body.

Therapeutic Indications.—The narrowing of the intra-abdominal

[1] *Archiv f. klin. Med.*, 1886.

vessels would naturally produce change of function in the organs supplied by them. Hence we have here an excellent method of treating the most obstinate cases of diarrhœa, in sitz baths of 54° to 60° of half an hour's to one hour's duration, or longer with care, preceded by a good wet sheet rubbing to dilate the cutaneous vessels and thus aid the derivative effect. In menorrhagia, subinvolution of the uterus, and pelvic cellulitis these baths are exceedingly useful, inasmuch as they reduce local temperature, diminish hyperæmia, increase the tone of the muscular fibre and that of the coats of the pelvic vessels, and enhance local tissue-changes.

In obstinate amenorrhœa dependent upon local anæmia, as is mostly the case, brief sitz baths of from 40° to 50° for eight or ten minutes, with friction, and repeated twice a day, are useful as driving blood to the pelvic vessels, and by reaction withdrawing it again to the surface.

In a depressed condition of the sexual function of the male the same treatment is useful. Care, however, should be exercised in seminal emissions to ascertain the cause, if possible, since many cases of hyperæsthesia would be aggravated by these cold baths, while warm or more temperate baths would be useful. Warm sitz baths are useful as agents to diminish the activity of the cerebral circulation.

In acute and subacute amenorrhœa, cystitis, intestinal and vesical tenesmus, prolonged baths of from 90° to 100° are valuable remedies. In chronic metritis, subinvolution, and all troubles accompanied by bearing-down and lumbar pains a graduated sitz bath has been with me among my most useful procedures for twenty-five years. It is best taken before retiring. The patient seats herself in a hip-tub containing water at 95°, to which she adds slowly (without touching the body) cold water (less than 50°) until she feels chilly. Upon rising she dries the skin and practises thorough friction. Many other uses of the hot and cold sitz baths will suggest themselves to the practitioner who understands their *rationale.*

The Use of Water in Cavities of the Body.

This is a special branch of hydrotherapy which has been developed within the last two decades into an important one.

Stomach Irrigation.—To Leube and Kussmaul we are indebted for the popularization of stomach irrigation, which for diagnostic and therapeutic purposes I have found of immense value. The technique consists of introducing one-third of a soft but firm rubber tube, sixty inches long and of a diameter of half an inch, into the stomach, pouring warm water through a funnel connected with the tube into the stomach, and allowing it to run out by siphonage into a vessel. The end of the tube being held between the thumb and forefinger, it is pushed into the pharynx through the open mouth, while the patient is asked

to swallow. Gagging results, but gentleness and calm persuasion overcome the patient's fear of choking. About a pint of water is poured in at once to avoid over-distension. It is well to protect the patient's clothing by a rubber or oilcloth sheet.

For diagnostic purposes about one and a half to two quarts of warm water, poured in five hours after a full meal, suffice. The water emitted will show what portions of the food are not digested, how much if any mucus is present, and the muscular power of the gastric walls will be tested by the readiness with which the stomach expels the water.

For therapeutic purposes the chief value of these irrigations is found in gastric catarrh with enfeebled muscular walls, which permit over-distension and lessen the motor-power of the stomach.

In some cases of hepatic colic from gall-stone, and even in cases of ileus, Rosenthal, Kussmaul, Senator, and others have applied stomach irrigation with so much success that this measure should always be tried before resorting to surgical means.

In the gastro-intestinal disturbances of infants Ebstein and Leo in Germany and Seibert in this country have obtained excellent results from stomach irrigation, which I can endorse from personal observation. It will remove all fermented and fermenting material from the stomach, and give a clean beginning, which aids in the digestion of sterilized milk.

Intestinal irrigation is another hydriatic procedure that is now commonly resorted to with great benefit.

In catarrhal jaundice Krull has shown us how to cure cases rapidly by daily irrigating the bowels with water of from 60° to 75°, and I can testify to its value from personal experience. The effect is explicable upon the experiments of Bidder and Schmidt, Lehman, Roehrig, and others, who have clearly proved that the introduction of large quantities of water into the stomach and intestines produces a more decided increase of bile than the entrance of water into the blood.

In acute and subacute dysentery the removal of irritating matters and pathological products, added to the soothing effect of the warm water, will do more to allay tenesmus and cure the disease than all other remedies combined.

In the obstinate intestinal catarrhs of infants and in acute summer diarrhœa I rely upon intestinal irrigation with warm alkaline water to bring relief in the most unpromising cases. Indeed, I view these alarming cases with indifference, since abstinence from milk food, and its sterilization later, together with stomach and intestinal irrigation and cool baths and compresses, have become my chief reliance.

The *hot vaginal* douche need only be referred to here as a hydriatic procedure of well-recognized therapeutic value. It should be applied with careful attention to the details established by its originator, Dr. T.

A. Emmet, who, if he had made no other contribution to gynecology than this, has earned the lasting gratitude of suffering women. The flat douche-pan devised by Dr. H. T. Hanks, and the use of the Davidson or "alpha" syringe with large quantities of water at 110°, constitute the important technical trio.

In post-partum hæmorrhages there is no remedy equal to hot irrigation of the uterus, with proper provision for outflow from the cervix.

Surgical Asepsis, it may be claimed with justice, owes more to hydrotherapy than to all else for its efficiency. The irrigation of operative fields and wounds with warm water is far more valuable than antiseptics, as the profession is slowly beginning to appreciate.

Water-Drinking.

This is a therapeutic auxiliary which is too highly lauded and carried to an extreme by the hydropaths, and yet is too much neglected by the profession.

The drinking of hot water before meals has become quite a routine practice now. Here, again, precision is demanded to prevent failure. The water should be as hot as it can be borne, and drank at least an hour before each meal.

Drinking large quantities of water of different temperatures produces definite effects. Water of 60° or less in moderately large quantity reduces, according to Lehman, the pulse for about eleven minutes, and the rectal temperature falls.

The absorption of water from the gastric vessels depends upon their tension, being most rapid when the latter is low.

The idea that the imbibition of large quantities of water renders the blood more watery is erroneous. Boecker has clearly shown that this is a very transient result, and that in half an hour the blood is really less watery than it was after twenty-four hours' abstention from water. It acts as a diuretic, not alone increasing the watery parts of the urine, but also the solids, especially the urea and the phosphates and sulphates. This would indicate an enhancement of retrograde metamorphosis of nitrogenous material. This is also confirmed by an increased carbonic-acid excretion and oxygen absorption when large quantities of cold water are consumed.

An interesting observation by Mosler is to be remembered as of practical value. He has found that the consumption of large quantities of water produces more decided effects upon women and children than upon male adults. Drinking large quantities of cold water increases peristaltic action, as evidenced by the expulsion of gases. The quantity of uric acid is also said to be decreased when water is drunk, and other secretions, as that of the parotid gland, are increased. Diaphoresis is certainly increased by copious water imbibition.

It follows, therefore, that the *therapeutic indications* for drinking water are found in all those diseases in which a rapid interchange of tissue-materials is desired, or in which elimination of pathological material is to be facilitated, or in which diaphoresis or diuresis is to be stimulated. Too little use is made of this important physiological modifier by the general practitioner.

Hot-air and Vapor-baths.

As auxiliary measures to hydrotherapy the so-called Turkish and Russian baths are often used.

The French constantly apply the hot-air baths by means of a box in which the patient is surrounded by hot air (furnished by a lamp), while his head is outside, as a preparatory measure for their douches. This is far superior for remedial purposes to the usual Turkish baths, in which the patient is compelled to inhale hot air, often rendered noxious by the enforced restriction of ventilation. At the Montefiore Home the boxes shown in Fig. 135, *F*, *G*, are supplied by a steam coil, which elevates the temperature of the air to 130°, and 150° if necessary. Very high temperatures are really not needed. My method is to be guided by the effect upon the patient's temperature, which may readily be taken in the mouth, and by his pulse. If the former is raised from one-half to one degree, and the skin is in active perspiration, and if the pulse is accelerated to over 120, the patient is removed and subjected to such hydriatic procedures as are indicated in the case.

The usual method of gradually reducing the temperature of the water is doubtless pleasant, and perhaps useful in health, but in disease it neutralizes the reflex effect upon the peripheral nerves, as has been mentioned above.

The vapor or Russian bath may be produced also in the box bath by permitting steam from a pipe to permeate it, and providing for its escape.

The ordinary baths of this kind supplied in establishments are so familiar that it is unnecessary to describe them, as they abound in all places where they are used, and their modification by boxes or cloaks enables the practitioner to imitate them successfully even in the remotest rural districts.

The rationale of these baths has been dwelt upon already. They raise the temperature, increase the pulse and respiration, and enhance tissue-metamorphosis. They are therefore invaluable in rheumatic and gouty affections and in some cases of chronic nephritis and in obesity. In the latter the hot vapor-bath, followed by cold douches, is to-day the most useful auxiliary to diet and muscular exercise.

Sand- and Mud-baths.

The first of those is prepared by surrounding the body in a tub with a layer of dry warm sand which has been naturally or artificially heated. The temperatures usually applied are from 95° to 120°, and their duration one to one and a half hours. The head is wrapped in a wet towel and permitted to lie outside of the sand. After removal from the sand-bath the body is treated as after a hot-air bath. By this means the pulse and respiration are accelerated as in other warm baths, and profuse perspiration ensues.

The mud-bath is prepared by mixing well-seasoned earths, containing more or less mineral matter, with water containing the same substances, and surrounding the body with this mixture at various temperatures from 90° to 100°. After the mud-bath the patient is rinsed with warm water, and as a large quantity is required to cleanse him of the filthy mass, he really obtains a prolonged bath in addition.

Kisch claims he has ascertained sphygmographically that these baths elevate the tension of the vascular system more than the ordinary warm bath, and as they may be given at a much higher temperature, their effects are more decided.

The therapeutic indications for the use of sand- and mud-baths are various, and they may be given either partially or completely. They act as emollient or heat-enhancing procedures, according to their temperature.

In uterine diseases of indefinite character, not amenable to surgical treatment, mud-baths may be of value. It is difficult to understand how any mineral admixture can be expected to be useful, since it is a well-established fact that they are never absorbed through the uninjured skin. Still, they have been found very useful in obstinate rheumatism and gout, and in Franzesbad for uterine disease. It is claimed by Kisch that the iron mud-baths cure enlargement of the spleen. How much the psychical element and subsequent douching contribute to the cure is still undecided. There is certainly sufficient demonstrated value in these baths to entitle them to a fair trial.

General Conclusions.

An unbiassed review of the physiological observations of the action of water explains at once the seeming paradoxical effects of hydriatic procedures upon the human body, and offers a rational warrant for the remarkable historic fact that amid all the vicissitudes of therapeutics water is the only remedy which has successfully resisted the prejudices of medical men and of the laity.

Hydrotherapy has maintained its position, not only on empirical grounds, but it is to-day more firmly entrenched in the minds of

progressive medical men than it ever was before, simply because *it is based upon well-ascertained and exact physiological facts*, the application of which forms the most brilliant chapters of clinical medicine.

It is, however, far from the writer's intent to enter into a propaganda for hydrotherapy as an exclusive treatment of disease, and thus rank himself with those empirics, the hydropaths, who have done much to discredit the remedial value of water. He would stultify his entire record were he to announce his adhesion to so absurd a doctrine.

Aside from the valuable medicinal acquisitions of the past, modern research has given and is still giving us remedies whose exact and positive effects upon the system are startling, and must, when they are fully appreciated after the enthusiasm of novelty passes away, enrich our therapeutic armamentarium vastly. It does not detract from these to bring forward a plea for this ancient and well-tried friend of the physician, whose triumphs at the bedside have been recorded by some of the best and ablest exponents of medical science. I plead for a fair and impartial test of water as a therapeutic resource, based upon its historical record, its physiological rationale, and its clinical results.

Whosoever shall read the history of this therapeutic agent from the time of Hippocrates, and pass in review some of the men who from time to time warmly espoused its many-sided advantages, must conclude that its claim on this score commands our highest respect. Since the day of Priessnitz (who built up a stupendous empirical structure upon water as a sole remedy), however, medical men have stood aloof and permitted his followers to monopolize the valuable properties of this agent. Its revival was brought about by French physicians, who at that time did not look askance at German medicine, but even went to the extreme of studying German empiricism. The celebrated French physician Scoutetten, who had been sent by Marshal Soult to Graefenberg, brought back a favorable report, which stimulated the adoption of hydrotherapy by French physicians, among whom it is at the present time much in vogue in acute and chronic diseases, chiefly in the treatment of the latter, as taught by Charcot and Dujardin-Beaumetz. It was not until 1861 that the Germans were again aroused to a realization of the remedial value of water by Ernst Brand. Niemeyer, Bartels, Juergensen, Hoffman of Leipzig, Vogl of Munich, Nothnagel, Fuerbringer, Erb in Germany, Semmola and Cantani in Italy, are names familiar to students of modern medicine which stand as vouchers for the good repute of hydrotherapy in recent times. One man stands above all others—Wilhelm Winternitz, to whom we owe nearly all we know of modern scientific hydrotherapy. In this essay his work has been so often utilized that it would be tiresome iteration to quote him again.

It is my aim to stimulate a revival of hydrotherapy, as far as lies in my power, by a plain, unvarnished exposition of its methods and results from the most reliable sources, but not to encourage its application as a sole remedy to supplant all approved medicinal or other agents.

To sum up the aims, capabilities, and results of hydrothorapy, it may be said—

1st. We possess in this method a valuable auxiliary to methodical treatment of many, though not all, acute and chronic maladies.

2d. In acute diseases its value is most demonstrable in the *early* stages of pyrexia, in which it will accomplish more than any other remedies; it may also be usefully applied in non-infectious diseases of short duration.

3d. In many chronic diseases it has proved so successful after failure of medicinal remedies that *no case should be yielded up as hopeless until hydrotherapy in some form has been tried.* My experience at the Montefiore Home, which receives only incurable cases, demonstrates this fact.

4th. Domestic treatment by the methods here indicated will suffice in most cases, but if these fail a methodical treatment under an expert hydrotherapeutist may be to the advantage of the patient.

The most important elements are the thorough mastering of the general principles of hydrotherapy, precision in their application, and their perfect adaption to the constitutional peculiarities of each case—*i. e. not treating the disease, but the patient.* For this reason the best consultants in Germany, in Italy, and in France—men like Leyden, Charcot, Senator, Semmola, Ziemssen, Krafft-Ebing, Bernhardt, Mendel, Nothnagel, Binswanger, Erb, and Leube—send their patients to hydrotherapeutic establishments which are under the direction of educated physicians who have studied the subject, with their diagnosis and general suggestions, rather than with specific directions for the method to be employed.

Finally, so much depends upon the reactive capacity of each patient that only systematic observations can determine the most useful hydriatic procedure in each case.

MINERAL SPRINGS.

BALNEOLOGY concerns itself with the study of the chemical, thermic, and other properties of waters issuing from the earth, and Balneotherapy deduces therapeutic results from this study.

Although an immense literature has accumulated concerning this

subject, the precision which modern medicine demands is still lacking. Unfortunately, the accuracy of the empirical results of balneotherapy are woefully marred by the bias due to one-sided study and observation of men who, be they ever so honest, must be misled by their environment and their constant advocacy of certain waters with which their personal interests are intimately interwoven. Thus, we are confronted in this question with far greater difficulties than in the discussion of ordinary therapeutic questions. In the latter we are able to obtain observations from various sources—from men living in different countries and unbiassed by local pride or interest; we are able to classify the results as recorded in polyclinics and hospitals as well as in private practice. Moreover, the observations are usually made upon one single pharmaceutical product. In the matter of mineral waters, on the contrary, we have many other elements to consider. The observations of each water can be made only at the springs from which it issues, with few exceptions; there are a large number of ingredients in each water, rendering it impossible to ascribe therapeutic effects to one or more in particular, although this is constantly attempted; there are other elements, such as the general effect of bathing or drinking, the climate, the surroundings, etc., to be considered. These considerations furnish a reason for the scepticism which the logical and unbiassed observer must entertain toward the effects of baths and mineral springs outside of their hydrotherapeutic influence. A few facts seem to me to be deducible from a careful survey of the subject.

In the first place, it must be conceded that since no precise observations in sufficiently large numbers are available for the physiological study of baths and mineral waters, we must be guided entirely by the practical results based upon empirical observations.

That visits to mineral springs are of immense value in the treatment of disease no one can be more ready to grant than the writer, for it is a matter of daily observation that patients afflicted with all kinds of curable and incurable maladies journey to these resorts and return from them either cured or greatly improved. To analyze the rationale of these positive effects is an undertaking which the writer would have preferred to leave to others. The following propositions seem to him quite plain, however:

1st. The effects of bathing in mineral waters differ very slightly, if at all, from those of bathing in ordinary water.

Although there are a few (very few) observations claiming, like those of Heidenhain and Roehrig and Zuntz, that baths containing salts or gases have a stimulating effect upon the skin of animals, these experiments have, as Leichtenstern has clearly shown, no significance. Moreover, they have not been authentically demonstrated on man, who is so frequently under observation that it would not be difficult to

obtain them if they could be made positive. Suffice it to say, that Liebermeister and Rembold's experiments with cold salt baths, and Leichtenstern's with warm salt baths, show no difference in temperature effect from plain water baths.

The fallacy of experiments on the effect of mineral-water baths cannot be better exposed than to cite one usually much quoted. Flechsig, who took the greatest care to ascertain the effect of lukewarm iron baths compared with those of plain baths, analyzed all the food he took and all the excreta, but was unable to investigate gaseous baths and ingesta because his apparatus was imperfect. Although he made these investigations alternately while using the different baths, he paid no attention to the kind of food, which he took as his appetite prompted. I agree with Leichtenstern in regarding this inexactness as an evidence of unreliability of the experiments, even though made by one of the best-informed and unbiassed of balneologists.

In brief, there is no evidence to prove that baths of chloride of sodium, for instance, have a specific power on absorption processes; that baths containing iron increase the hæmoglobin, or that there is any specific action in sulphur baths in eliminating metallic or rheumatic poisons, as is so constantly claimed. That absorption of water may occur in the surface layer of the skin cannot be doubted, but its penetration beyond the inner layer has never been proved. The fact is, the water absorbed is again evaporated: Roehrig proved on his own person that after a salt bath of an hour for five days there was no increase of chloride of sodium in the urine over that of the previous five days. On the other hand, Neubauer and others claim an increase of chloride of sodium from such baths, which, however, is so small that it may be accounted for by the ordinary variations. The best evidence that mineral constituents of baths are not absorbed into the system is furnished by numerous experiments by Lehman and others with ferrocyanide-of-potassium baths, of which not a trace could be found in the urine, and of lithia baths, whose presence in the urine even spectral analysis could not demonstrate. *Indeed, all agents* (as arsenic, copper, morphine, antimony, belladonna, etc.) *dissolved in water that were not, like iodine, sulphur, etc., volatile, failed to appear in the urine.*

The fact that the skin is capable of absorbing matters contained in a finely diluted spray, or metals like mercury and iodine when well rubbed in and volatilized, or gases like chloroform, carbonic oxide in concentrated form—all of which it has been demonstrated are absorbed—does not prove aught in favor of absorption from water. It has been amply demonstrated that the oleaginous nature of the sebaceous secretions utterly bars out aqueous absorption, but that this may be overcome by friction and neutralization with alkaline soap, which, however, very rarely play any part in the usual mineral-water baths.

It may be safely concluded, without depreciating the value of the other elements concerned in the resort to mineral-water baths, that aside from their volatile ingredients their effect is not due to their mineral constituents.

It should by no means be inferred that the writer is averse to their use, for the psychical effect is far more valuable than any chemical effect would be if available. All the effects, too, of ordinary bathing are enhanced in these mineral baths, because the environment of the patients, the influence derived from fellow-patients—some of whom are always found ready to laud the baths—etc. render this mode of bathing far more agreeable than the hydrotherapeutic procedures described in the first part of this article.[1]

Drinking of Mineral Waters.—Here, again, several elements are operative:

1. The exhilaration due to the improved hygienic, atmospheric, and scenic conditions under which the patient is placed;
2. The freedom from care and absence from business pressure, together with the stimulus of amusements and diversion;
3. The regularity of habit inculcated, together with the strict diet and regimen;
4. The drinking of unwonted large quantities of fluid, which sweeps out effete material;
5. The mineral ingredients.

The latter two chiefly concern us here.

In drinking water the effect depends upon the temperature and quantity imbibed. Cold water taken on an empty stomach produces contraction of the muscular coats of the stomach and its vessels, a reduction of the body temperature, and also some effect on the intestinal muscular coats.

Warm water, on the contrary, exerts its chief effect as a cleansing agent of the mucous membrane of the stomach and as a stimulant to its secretions. Hot water exercises a beneficial influence as an antifermenting and cleansing agent.

The imbibition of much water produces a certain over-saturation of many tissues, and decided fluctuations in the excretion of urea result, without, however, materially affecting the average production.

Many of the glands, as the parotid, pancreas, and liver, feel such an active impulse as a result that water-drinking has been successfully applied as a stimulant to their functional activity.

It is well known that water containing salts is more rapidly

[1] American springs would be far more popular were the method of using them less irrational. If physicians at these resorts would insist upon precision in drinking and upon attention to diet, hydrotherapy proper, and exercise, facilitating these auxiliaries, as is done in Europe, the annual exodus from this country would be greatly diminished.

absorbed through the veins and lymphatics when taken upon an empty stomach, and that the rapidity of its absorption depends upon the concentration of the salt, because a 2 per cent. solution of salts would render osmosis difficult or impossible.

The heart is stimulated to increased action by excessive water-drinking. That the blood is rendered markedly dilute by drinking large quantities of water is not proved; indeed, this is denied by so good a physiologist as Magendie and by many others.

A decided effect upon tissue-changes results, however, especially if large quantities of warm water are taken.

The effects of free drinking of water, therefore, may be summed up in the saturating of the tissues, the increase of vascular tension and capillary pressure, and the solvent action upon various pathological and chemical elements residing in the body. The therapeutic results may be logically deduced from these.

Phoebus has with great labor calculated the quantity of each constituent of mineral water which must be consumed in twenty-four hours in order to obtain in ordinary conditions the therapeutic effects expected. He calls his deductions, made from observations of himself and others during ten years of the actual remedial effects of these ingredients, pharmaco-dynamic equivalents. Taking five goblets, or one litre, as an average daily quantity, he places these values—therapeutic equivalents—for each ingredient per litre per day as follows:

Carbonic acid	3 grammes.
Simple carbonate of sodium	1 gramme.
" " lime	1.50 grammes.
" " magnesium	1.50 "
Chloride of sodium	3 "
Sulphate of sodium	1.50 "
" magnesium	1.50 "
Chloride of calcium	0.60 gramme.
" magnesium	0.90 "
Iodine (in all combinations)	0.35 "

In waters of which a litre is not consumed per day the value—therapeutic equivalent of the chief ingredient, *e. g.* the sulphates in the bitter waters—is very high. We find here, approximately, the contents of each goblet by dividing the therapeutic equivalent by five (Kisch).

Uses and Classification of Mineral Waters.

A large number of classifications have been proposed in this country and in Europe. Some of them are based upon the therapeutic action of the waters, while others have been made with the view of indicating their chemical constitution. After a careful study of the

various classifications adopted here and in Europe, it seems to be most conducive to a proper understanding of the subject to employ a somewhat different system, which, while not free from imperfections, has, at any rate, the merit of simplicity.

Inasmuch as the therapeutic action of any given mineral water is supposed to depend upon the character and quantity of its chief chemical ingredients and upon the temperature of the water, any classification which embodies these points must approximate most nearly to a perfect system. Owing to the fact that some of the waters contain large quantities of various chemical constituents having different therapeutic properties, it becomes necessary to refer to them under several headings. Only the mineral waters of America and Europe which have been analyzed by competent chemists, and the merits of which have been generally recognized by the medical profession, will be mentioned here. A large number of springs in various parts of this country, which, although comparatively unknown, possess positive medicinal virtues, have been omitted, the aim being to furnish the practitioner with a number of characteristic examples of each class, depending upon his individual discrimination to select waters, approximating these in chemical composition in cases where their use is indicated. It will also be shown that this country boasts of mineral springs rivalling, if not surpassing, in virtues the most celebrated ones in Europe, and that if more attention was paid to the hygienic and social conditions at our health-resorts, and to the development of their scenic beauties, the results obtained would be fully equal to those observed on the continent of Europe.

Mineral waters may be divided into—1, alkaline; 2, saline; 3, sulphuretted; 4, chalybeate; 5, acidulous; 6, waters characterized by special ingredients (alum, sulphuric acid, borax, iodides, bromides, etc.); 7, calcareous; 8, thermal. In estimating the value of any of these waters due consideration should be given to the mere effect on the system of drinking large quantities of water—an effect which probably exceeds in therapeutic value that produced by the mineral ingredients, which are frequently present in minimal quantities.

Alkaline Waters.

The chief ingredients of these waters are the alkaline carbonates, especially the carbonate of sodium. They also contain varying amounts of the carbonates of lime, magnesium, and lithium, sodium chloride, etc., and many of them are strongly charged with carbonic acid gas. Although it is probable that the other saline constituents may contribute to the total physiological effect of these waters, they owe their main therapeutic activity to the alkaline salts they contain. The temperature of these springs is also a point worthy of consideration, as has

been mentioned above. In the section on thermal waters we will discuss these effects *in extenso*.

In a general way, it may be said that the physiological action of these waters is like that of any alkaline salt, plus the effect produced by the circulation of large quantities of water in the system. The carbonate of sodium neutralizes free acids or fermentation-products in the stomach whether taken during or after meals. According to Brunton and Sidney Ringer, the stronger alkaline waters, if taken before meals, increase the secretion of gastric juice. The carbonic acid set free by the decomposition of the carbonates in the stomach, and the sodium chloride usually present in these waters, act as a stimulant to the gastric mucous membrane, promoting secretion and counteracting any disturbing influence exerted by the carbonate. The free carbonic acid frequently contained in waters of this class by its stimulating effects on gastric peristalsis accelerates digestion and thereby increases the desire for food.

Absorbed into the blood, the carbonate of sodium in the water augments its alkalinity, and thus promotes oxidation processes and tissue-metabolism. Under its use the urine becomes alkaline, the quantity of urea is greatly increased, while that of uric acid is correspondingly diminished. The function of the mucous membranes throughout the body is stimulated, and thus, according to Flechsig, these waters become anticatarrhal remedies of a high order. It has been generally supposed that the alkalies increase the oxidation of fats and sugars, and to this effect has been attributed the curative action of such waters as Marienbad and Carlsbad in diabetes; but this theory has been controverted by Leichtenstern.

It would appear, therefore, that the alkaline waters have a wide range of usefulness. They seem to be especially indicated in gastric affections in which there is an excessive production of hydrochloric acid, as in acid dyspepsia, atony of the gastric mucous membrane, and gastric ulcer. In all catarrhal conditions of the stomach they are most serviceable, but a free and prolonged use lowers the nutrition, except in the case of those waters containing chloride of sodium. Catarrhal inflammations of the mucous membranes of the respiratory tract are frequently benefited by a course of alkaline waters, owing to their action in augmenting and liquefying the mucous secretions. They have proved themselves excellent expectorants in acute and chronic laryngitis and bronchitis, especially the thermal members of this group. It is, however, especially in catarrhal conditions of the bladder that they enjoy a high reputation for efficacy. They neutralize the acid of the urine, and thus rid it of its irritating effect upon the vesical mucous membrane; and, aside from this, they probably exert a direct anticatarrhal action.

In the uric-acid diathesis and in lithæmia they promote the oxidation of excretory matter and dissolve uric-acid deposits; and for this reason those containing sulphate of sodium especially, which stimulates the portal circulation, have been highly recommended in gout and rheumatic affections, hepatic hyperæmia, and obesity. In all these conditions, as already stated, the effect of the alkali is supplemented by the large quantities of water imbibed, which flush the emunctories and dissolve and drain away the products of tissue-metabolism. The experiments of Lewaschew have shown that the carbonate of sodium promotes the biliary secretion; and this effect may be utilized in the treatment of diseases of the gall-bladder and bile-ducts.

The following table presents a small number of characteristic alkaline springs of America and Europe, arranged in such manner as to enable the practitioner to draw a comparison between *celebrated* waters of this class in Europe and those in this country resembling them in composition. For the purpose of simplicity the quantities of active ingredients are given in round numbers, and no attempt has been made to mention all the constituents, since some of them are present in such extremely small amounts that they cannot be regarded as contributing to the medicinal properties of the waters:

Illustrative Comparative Chart of Alkaline Waters.

American.	European.	One pint contains—			
		Sodium Carbonate.	Carbonic Acid Gas.	Temperature.	Other Important Constituents.
		grs.	cub. in.	Fahr.	
	Vichy (Grande Grille Spring), France.	26	14	105.8°	Sodium chloride, 4; sodium sulphate, 2; potassium carbonate, 2 grains.
Ojo Caliente Spring, California.	. . . . .	14	. . .	100°	Sodium chloride, 4; sodium sulphate, 1 grain.
	Fachingen Spring, Germany.	19	32	50°	Sodium chloride, 4; calcium carbonate, 2 grains.
Saratoga Vichy Sp'g, New York.	. . . . .	11	48	50°	Calcium and magnesium carbonates, 17; sodium and potassium chlorides, 18 grs.
	Ems (Kesselbrunnen Spring), Germany.	10	6	115°	Sodium chloride, 7; calcium carbonate, 1 grain.
St. Louis Spring, Michigan.	. . . . .	7	1	50°	Calcium and magnesium carbonates, 6; calcium sulphate, 7 grains.

It will be seen from the foregoing table that the European waters of this class are somewhat richer in alkaline salts than the American. Besides those already mentioned, a large number of alkaline waters occur in Europe and this country, from which the following have been selected as examples:

Europe: Mont Doré, Royat, and Vals in France; Apollinarisbrunnen, Geilnau, Obersalzbrunn, Selters, and Weilbach in Germany;

Bilin, Giesshübel, Franzensbad, Karlsbad, Marienbad in Bohemia; Gleichenberg (Johannisquelle), Rohitsch in Styria; and Luhatschowitz in Moravia, Austria; Passug and Tarasp in Switzerland.

America (*United States*), *Alabama:* Bladon Springs, Choctaw Co.—*California:* California Seltzer Springs, Mendocino Co.; Congress Springs, Santa Clara Co.; Napa Soda Springs, Napa Co.; Vichy Springs, Santa Clara Co.—*Colorado:* Manitou Spring, El Paso Co.—*Illinois:* Perry Springs, Pike Co.; Versailles Springs, Brown Co.—*Oregon:* Lower Soda Spring, Linn Co.—*Vermont:* Sheldon Springs, Franklin Co.; Middletown Springs, Rutland Co.; Welden Spring, Franklin Co.—*Virginia:* Jordan Alum Springs, Rockbridge Co.; Orkney Springs, Shenandoah Co.—*West Virginia:* Capon Springs, Hampshire Co.—*Wisconsin:* Bethesda Springs, Waukesha Co.

Saline Waters.

This class may be conveniently subdivided into, first, waters containing chiefly the chloride of sodium; and second, waters containing large quantities of the sulphates of sodium and magnesium, the so-called bitter waters of German authors.

The Sodium-Chloride Waters.—These waters contain, besides large quantities of sodium chloride, a certain proportion of other chlorides, especially those of lime and magnesium, and small amounts of alkaline and earthy sulphates and carbonates, iodides and bromides. Carbonate of iron is sometimes present in considerable quantity. The gases consist for the most part of carbonic acid, which renders the water more agreeable to the palate and more readily absorbed, while some of these waters are heavily charged with sulphuretted hydrogen. They occur both as cold and thermal springs, and may be utilized for both drinking and bathing purposes.

The physiological action of these waters is chiefly attributable to the presence of sodium chloride. This salt, as is well known, has a stimulating effect upon all the mucous membranes of the body, especially that of the gastro-intestinal tract. In the stomach it dissolves the mucus, increases the secretion of gastric juice, promotes the digestion of albuminous substances, and excites peristalsis. In the intestines it stimulates the flow of pancreatic juice and bile, and owing to its well-known influence on the process of osmosis promotes the absorption of food. Intestinal peristalsis is also increased, and if the sodium chloride is present in large quantity the water may be laxative, and even purgative, in its effects. Some authors have regarded this purgative action as representing the chief therapeutic virtues of these waters, but, according to Flechsig, it is subordinate in importance to the effect of the sodium chloride on the blood. He states that this salt exerts considerable influence on the process of tissue-metabolism, augmenting the

metamorphosis of nitrogenous matters and increasing the oxidation of albuminous substances, as is shown by the increased quantity of solids in the urine. The iodides and bromides contained in some of these waters are usually present in such very minute amounts that it seems doubtful whether they contribute to their therapeutic action; and, at any rate, it is impossible to separate their effects from those of the sodium chloride.

The therapeutic indications of sodium-chloride waters, as based upon their physiological action, are sufficiently obvious. Their stimulant effects upon the mucous membranes have been utilized in the treatment of catarrhal processes, especially in the stomach and intestines. In chronic inflammations of the pharynx, stomach, duodenum, and bile-ducts, and in chronic intestinal catarrh associated with constipation, their use has been highly recommended. In congestive affections of the abdominal and pelvic organs, chronic endometritis, hepatic and splenic congestion, chronic inflammatory diseases of the respiratory tract, and in obesity, scrofula, and syphilis, they have also been employed with success, although their *modus operandi* in some of these conditions is not well understood. It is probable that their beneficial effect is attributable to the action of the saline in promoting osmosis and the absorption and excretion of inflammatory products.

Illustrative Comparative Chart of Saline Waters.

American.	European.	One pint contains—			
		Sodium Chloride.	Carbonic Acid Gas.	Temperature.	Other Prominent Constituents.
		grs.	cub. in.	Fahr.	grs.
	Homburg (Elizabethbrunnen), Germany	79	48	50°	Chlorides of calcium and magnesium, 15; calcium carbonate, 11.
Ballston Artesian Lithian Well, New York.	. . . . .	93	53	. . .	Magnesium and calcium carbonates, 34; potassium chloride, 4: lithium carbonate, 0.7.
	Wiesbaden (Kochbrunnen), Germany	52	17	155°	Chloride of potassium, 1; calcium carbonate, 3.
Hathorn Spring, Saratoga, New York.	. . . . .	64	47	47°	Calcium and magnesium carbonates, 28.
	Bourbonne (Fontaine Chaude), France.	46	. . .	149°	Calcium chloride, 5; calcium sulphate, 6.
Congress Spring, Saratoga, New York.	. . . . .	50	49	52°	Calcium and magnesium carbonates, 21; sodium bromide, 1.06.
	Kissingen (Ragoczi), Germany.	44	42	51°	Potassium chloride, 2; calcium carbonate, 8.
Kissingen Spring, Saratoga, New York	. . . . .	42	45	40°	Calcium and magnesium carbonates, 26; sodium carbonate, 8; lithium carbonate, 0.64.
	Selters, Germany.	17	30	62°	Sodium carbonate, 6.
Saratoga Seltzer Sp'g, New York.	. . . . .	17	. . .	50°	Sodium carbonate, 2; calcium and magnesium carbonates, 10.

A large number of saline springs exist in America and Europe, a

very strong water of this kind being St. Catherine's Well, in Ontario, Canada, which contains about 275 grains of sodium chloride to the pint, and 125 grains of chloride of calcium. Its prototype in Europe is the celebrated Kreutznach Spring in Prussia, which contains about 110 grains of sodium chloride to the pint (Kurbrunnen). The following list comprises some of the best-known waters of this class:

Europe, France: Balaruc, Salies de Beárn, Salins.—*Germany:* Adelheidsquelle, Baden-Baden, Colbery, Dürrheim, Frankenhausen, Friedrichshall, Kreutznach, Kronthal, Nauheim, Niederbrunn, Pyrmont, Reichenhall, Soden, Sulzbrunn.—*Austria:* Gmunden, Hall, Salzburg.—*England:* Cheltenham, Leamington.—*Switzerland:* Bex, Rheinfelden.

America (*United States*), *Alabama:* Livingston Artesian Well, Sumter Co.—*Colorado:* Cañon Mineral Spring, Fremont Co.; Siloam Spring, Garfield Co.—*Indiana:* La Fayette Artesian Well, Tippecanoe Co.; Lodi Artesian Well, Wabash Co.; Ott's Well, Crawford Co.; Terre Haute Spring, Clay Co.—*Kentucky:* Blue Lick Springs (Upper and Lower), Nicholas Co.; Salt Sulphur Spring, Bath Co.—*Michigan:* Fruit Port Well, Ottawa Co.; Lansing Well, Ingham Co.—*Missouri:* Akesion Spring, Saline Co.; St. Louis Artesian, St. Louis.—*New York:* Albany Artesian Well, Albany; Ballston Springs (United States, Ballston Artesian Lithian Well, Franklin Artesian Well, Condo Dentoneau Well (which is the strongest lithia water extant), Ballston Spa), Saratoga Co.; Halleck's Spring, Oneida Co.; Saratoga Springs (High Rock, Red, Congress, Columbia, Hamilton, Washington, Putnam, Star, Pavilion, Empire, Excelsior, Seltzer, Union, Eureka, Geyser, Crystal, Champion, Kissingen); Syracuse Salt Wells, Oneida Co.—*Pennsylvania:* East Clarion Salt Spring, Elk Co.; Salina Spring, near Tarentum; Salt Spring, Bradford Co.; Salt Water, Indiana Co.—*West Virginia:* Borland Well, Wood Co.; Kanawha Spring, Kanawha Valley.—*Wisconsin:* Sheboygan Well.

Canada: Caledonia Springs, Ontario; Caxton Springs, Quebec; Sandwich Springs Ontario; St. Catherine's Well, Ontario.

Bitter or Purgative Waters.

This name has been applied to waters characterized by a high percentage of the sulphates of sodium and magnesium. They also contain considerable quantities of the sulphates of lime and the carbonates of lime and magnesium, and sometimes, though rarely, small amounts of carbonic acid gas. Carbonate of sodium, however, is seldom, if ever, found in them.

The chief physiological action of these waters is comprised in the stimulating effect which they exert upon the mucous membranes of the gastro-intestinal tract. They give rise to a profuse watery secretion of

a serous, or even mucous, character, and thus act as purgatives. If partaken of in large quantities, they frequently produce gastric and intestinal disturbances, and their protracted use is apt to be followed by atony of the intestines and intestinal catarrh. It is as yet a matter of speculation whether this purgative action is due to the increased exudation of fluids or whether it results from the stimulation of intestinal peristalsis, as is assumed by Flechsig and others. Owing to the increased peristalsis, the passage of food through the intestines is accelerated, and in consequence of the diminished absorption of nutriments engendered by this a loss of weight and disappearance of the fatty tissue result.

It follows from the above considerations that the use of these waters is restricted to cases in which we desire to stimulate the intestinal secretions, as in chronic constipation occurring in plethoric persons, engorgements of the abdominal and pelvic viscera, hæmorrhoids, etc. They may also prove serviceable in cases of obesity as part of a treatment of denutrition. On the other hand, their use is contraindicated in anæmic persons and where there is great irritability of the stomach and intestines, with a tendency to diarrhœa.

Illustrative Comparative Chart of Bitter Waters.

American.	European.	One pint contains—				
		Sodium Sulphate.	Magnesium Sulphate.	Carbonic Acid Gas.	Temperature.	Other Prominent Constituents.
		grs.	grs.	cub. in.	Fahr.	
	Püllna, Bohemia.	124	93	. . .	. .	Chloride of magnesium, 16; magnes. carb., 6 grains.
Crab Orchard, Foley's Sp'g, Ken.	. . . . .	7	25	. . .	. . .	Calcic carbonate, 7; potassium sulphate, 1 grain.
	Friedrichshall, Germany.	41	39	5	46°	Sodium chloride, 67; magnesium chloride, 31; calcic sulphate, 11 grains.
Estill S'pgs, Irvine Sp'g, Kentucky.	. . . . .	. . .	32	. . .	. . .	Calcic carbonate, 4; sodium chloride, 2 grains.
	Carlsbad (Sprudel), Bohemia.	19	. . .	8	162°	Sodium carbonate, 9; sodium chloride, 8 grains.
Bedford Springs, Pennsylvania.	. . . . .	. . .	10	9	58°	Chloride of sodium, 1; calcium sulphate, 2 grs.
	Marienbad (Kreutzbrunnen), Bohemia.	36	. . .	15	53°	Sodium carbonate, 8; sodium chloride, 11 grains.
Harrodsburg Sp'g, Saloon Sp'g, Ken.	. . . . .	. . .	28		. . .	Calcic sulphate, 10; sodium chloride, 1 grain.

The American waters of this class are somewhat weaker in sulphates of sodium and magnesium than the European, but the quantity of purgative salts present in the former is quite sufficient to produce active therapeutic effects. All these waters contain a considerable amount of sodium chloride, which contributes essentially to their physiological action. In the following list are given a number of bitter waters in Europe and America:

Europe, Germany: Mergenthlim, Grossenlüder.—*Bohemia:* Sedlitz, Saidschütz.—*Hungary:* Alap, Ofen (Hunyadi Janos, Franz Josef, Victoria, Arpad, Elizabeth).

America (*United States*), *Colorado:* Seltzer Spring, Boulder Co.; Pagassa Springs; Hot Springs, Cañon City.—*Georgia:* Catoosa Springs, Catoosa Co.; Indian Springs, Butte Co.—*Indiana:* Eaton's White Sulphur Springs, Crawford Co.—*Kentucky:* Bryant's Mineral Spring, Lincoln Co.; St. Louis Artesian Well.—*Michigan:* Midland Well, Midland Co.—*New York:* Avon Springs, Livingston Co.; Richfield Springs, Otsego Co.—*Ohio:* Green Springs, Sandusky.—*Oregon:* Beer Springs.—*Pennsylvania:* Bedford Springs, Bedford Co.—*South Carolina:* Glenn Spring, Spartanburgh Co.—*Virginia:* Blue Ridge Springs, Botetourt Co.

Sulphuretted Waters.

The constituent which gives these waters a distinguishing character is the sulphuretted hydrogen which they contain in greater or less amount. With it we find associated a varying quantity of sulphur combinations, such as the sulphides of potassium, sodium, calcium, and magnesium. They also contain the alkaline and earthy sulphates and carbonates, the chloride of sodium, and the sulphates and carbonates of iron, and these are frequently present in large quantities, and certainly play a not unimportant part in the therapeutic action of these waters. According to Daland, "a sulphur spring of moderate strength contains not less than 12 cubic inches of sulphuretted hydrogen in the gallon, though many springs contain so small an amount that therapeutically they are inert, and the good effects observed are due to the influence of the increased use of water, change of scene and climate, cessation of work, regular meals, good hygiene, and hope, all of which contribute strongly to restore health at all springs." Many of the sulphur waters are thermal and are chiefly employed in baths.

Nothing positive can be said regarding the physiological action of sulphur waters on the system. Various plausible theories have been proposed to account for their curative effects in the diseases for which they are employed. It seems probable that their chief action is exerted on the intestinal canal, where they stimulate the functions of the glands, increasing the secretions and producing laxative effects. When administered for a prolonged period they give rise to gastro-intestinal disorders and exert a debilitating influence upon the blood, heart, and lungs, as evidenced by anæmia, cardiac weakness, etc. According to Leichtenstern, the sulphuretted hydrogen absorbed into the blood is rapidly converted into sulphuric acid, and is therefore devoid of any specific effect unless present in very large amounts. On the other

hand, Stifft[1] concludes that the sulphuretted hydrogen has a specific excitant action upon the sensitive fibres of the pulmonary branches of the pneumogastric, and upon the respiratory, cardiac, and vaso-motor centres, its prolonged use giving rise to paralysis from over-stimulation. In this way he explains the action of the sulphur waters upon the respiratory and circulatory system, upon tissue-metabolism, and upon the secretory and excretory functions.

These waters have been administered internally in engorgements of the abdominal and pelvic viscera, especially in plethoric persons, in enlargement of the liver and spleen, hæmorrhoids, chronic intestinal catarrh, and chronic poisoning by metals. In the form of baths they have been recommended in gout and chronic rheumatism, but their curative effect in these cases is attributable to the elevated temperature of the waters, rather than to any specific action of the sulphuretted hydrogen or other constituents. At many baths the internal or local use of the waters is combined with inhalation of the gases or of the nebulized waters; and this method has been found useful in the treatment of chronic catarrhs of the pharynx, larynx, and bronchi.

The following chart illustrates the superiority of the sulphur waters of America:

Sulphuretted Waters (Illustrative Comparative Chart).

American.	European.	One pint contains—			
		Sulphuretted Hydrogen.	Sulphides.	Temperature.	Other Prominent Constituents.
		cub. in.	grs.	Fahr.	
	Neundorf, Germany.	1.28	0.55	53°	Calcium and magnesium sulphates, 10 grains.
Sandwich Spring, Ontario, Canada.	. . . . .	4.72	. . .	52°	Chloride of magnesium, 19; calcium sulphate, 15 grs.
	Aix-le-Bains, France.	0.82	. . .	108°	Calcium carbonate, 1 grain.
Sharon Sp'gs, White Sulphur Spring, New York.	. . . . .	2	0.28	48°	Calcium and magnesium sulphates, 24 grains.
	Harrowgate, England.	0.53	1.54	. . .	Sodium chloride, 86, potassium and magnesium chlorides, 10 grains.
Paroquet Spring, Kentucky.	. . . . .	3.75	. . .	. . .	Sodium chloride, 39 grains.
	Meinberg, Germany.	0.61	0.67	48°	Sodium sulphate, 6 grains.
Salt Sulphur Sp'gs, Iodine Spring, W. Virginia.	. . . . .	2.39	. . .	. . .	Sodium sulphate, 3; calcium sulphate, 8 grains.

The American waters of this class are more strongly charged with sulphuretted hydrogen than the European, and are especially numerous in New York and Virginia. In some places, as in Richfield Springs, provision is made for inhaling the gas or the finely-atomized waters. The following list contains a number of well-known sulphur springs in this country and in Europe:

Europe, France: Allevard, Ax, Bagnères de Luchons, Barèges,

[1] *Die Physiologische und Therapeutische Wirkung des Schwefelwasserstoffes*, Berlin, 1886.

Cauterets, Eaux-bonnes, Eaux-chaudes, Enghien, La Preste, Saint Sauveur, Vernet.—*Germany:* Aix-la-Chapelle, Höhenstädt, Kreuth, Langenbrücken, Langensalza, Reutlingen, Tannstädt, Weilbach.—*Hungary:* Grosswardein, Trenczin-Töplitz.—*Switzerland:* Alberneu, Gurniglbad, Lawey, Leuk, Schinznach.—*Great Britain:* Moffat and Strathpeffer in Scotland and Llandindrod in Wales.

America (*United States*), *Alabama:* Blount Springs, Blount Co.—*California:* Calistoga Springs, Napa Co.; Paso Robles Hot Springs; St. Helena White Sulphur Springs, Napa Co.—*Georgia:* Red Sulphur Springs, Walker Co.—*Indiana:* French Lick Springs, Orange Co.; Indian Springs, Martin Co.; La Fayette Springs, Tippecanoe Co.; Lodi Artesian Well, Wabash Co.; West Baden Springs, Orange Co.—*Kentucky:* Estill Springs, Estill Co.; Louisville Artesian Well, Louisville; Olympian Spring, Bath Co.; Paroquet Springs, Bullitt Co.; Upper and Lower Blue Lick Springs, Nicholas Co.—*Michigan:* Alpena Well, Alpena Co.—*New York:* Avon Springs, Livingston Co.; Cherry Valley Springs, Otsego Co.; Chittenango Springs, Madison Co.; Clifton Spring, Ontario Co.; Columbia Springs, Columbia Co.; Florida Springs, Montgomery Co.; Longmuir Well, Rochester; Massena Springs, St. Lawrence Co.; Richfield Springs, Otsego Co.; Sharon Springs, Schoharie Co.—*Pennsylvania:* Minnequa Springs, Bradford Co.—*Virginia:* Augusta (Stribling) Springs, Augusta Co.; Buffalo Springs, Mecklenburg Co.; Greenbrier White Sulphur Springs, Greenbrier Co.; Jordan's White Sulphur Springs, Frederick Co.; Kimberley Springs, Bland Co.; Roanoke Red Sulphur Springs, Roanoke Co.; Yellow Sulphur Springs, Montgomery Co.—*Vermont:* Alburg Springs, Grand Isle Co.; High Gate Springs, Franklin Co.; Newburg Springs, Orange Co.—*West Virginia:* Red Sulphur Springs, Monroe Co.; Salt Sulphur Springs, Monroe Co.

Chalybeate Waters.

A large number of mineral springs contain the salts of iron, but the quantity present is frequently so small as to be practically devoid of therapeutic effects. In the class under consideration only waters containing a sufficient quantity of chalybeates to be of value in the treatment of disease will be mentioned. The iron salts usually occur in the form of the carbonate or sulphate. The other constituents, which are sometimes present in large amounts, are the alkaline carbonates and sulphates, the earthy carbonates, sodium chloride, alum, and sulphuric acid. Alum often exists in considerable quantities, especially in the chalybeate springs of Virginia. Chalybeate waters containing the carbonate of iron are clear, odorless, have a slight inky taste, and are highly charged with carbonic acid gas, which renders them palatable. They are chiefly employed for drinking purposes. The sulphate-of-

iron waters have a marked astringent taste, which sometimes proves an objection to their use, and their astringency may be decidedly increased by the presence of alum.

The physiological action of chalybeate waters is essentially similar to that of all iron compounds: they promote constructive metamorphosis, increasing the number of red globules in the blood and stimulating all the body functions. For internal use the waters containing the carbonate of iron are preferable, since they are less apt to disturb the stomach and are more easily assimilated, owing to the carbonic acid gas present. According to the character of the case it may be necessary to select an iron water containing alkalies, sodium chloride, sulphate of sodium and magnesia, or alum.

The chalybeate waters have been recommended in anæmia, chlorosis, and all conditions attended with anæmia, such as hysteria and neurasthenia, chronic endometritis, dysmenorrhœa, amenorrhœa, chronic gonorrhœa and spermatorrhœa, chronic affections of the kidneys, diabetes mellitus, chronic gastritis, nervous dyspepsia, chronic diarrhœa, etc.

Among the iron and alum springs, Bedford Alum Spring has been found remarkably efficacious in chronic diarrhœa, which had resisted both private and hospital treatment by the writer. The contraindications to their use, as given by Flechsig, comprise all febrile and congestive conditions and advanced organic diseases of the lungs, liver, and kidneys. The sulphate-of-iron waters are excellent astringents and disinfectants, and have been highly recommended in chronic diarrhœa, gastric ulcer, etc.

The following chart illustrates the superior quality of some American chalybeate springs:

Chalybeate Waters.

American.	European.	One pint contains—			
		Sulphates of Iron.	Carbonates of Iron.	Carbonic Acid Gas.	Other Prominent Constituents.
Church Hill Alum Springs, Virginia.	Brighton, England .	1.80	. . .	. . .	Calcium sulphate, 4 grains.
	. . . . .	19.8	. . .	. . .	Magnesium and calcium sulphates, 22; aluminium sulphate, 9 grains.
	Spa (Buhon), Belgium.	. . .	0.67	71.6	Small amounts of calcium carbonate and alumina.
Rock Enon Springs, Virginia.	. . . . .	. . .	1.78	. . .	Calcium and magnesium sulphates, 2; calcium and sodium carbonates, alumina.
	Schwalbach (Stahlbrunnen), Germany.	. . .	0.46	50.2	Calcium carbonate, 1; manganese carbonate, 0.10 grain.
Vichy Springs, New Almaden, Cal.	. . . . .	. . .	0.60	29.8	Sodium carbonate, 17; calcium carbonate, 3; magnesium sulphate, 1; sodium chloride, 4 gr.
	St. Moritz (Grande Source), Switzerland.	. . .	0.17	39.2	Sodium carbonate, 1; calcium carbonate, 6; sodium sulphate, 1 grain.
Estill Springs, Kentucky.	. . . . .	. . .	0.23	4.15	Calcium carbonate, 1; magnesium sulphate, 1 grain.

The chalybeate springs of the United States differ from those of Europe especially in the large quantity of iron and alumina that many of them contain. The iron salt occurs in the form of a sulphate if free sulphuric acid is present, which is frequently the case. One of the most remarkable iron springs in the world is the Oak Orchard Spring in Genesee County, New York, which contains 10 grains of free sulphuric acid to the pint. Of the numerous waters of this class in Europe and America, the following have been selected:

Europe, France: Charbonnière, Lamalon.—*Germany:* Alexanderbad, Alexisbad, Elster, Griessbach, Hermannsbad, Homburg, Koenig Ottobad, Liebenstein, Pyrmont.—*Bohemia;* Franzensbad, Königswart, Sangerberg.—*Hungary:* Szliaco (Josephsquelle), Bartfeld, Parad.—*Tyrol:* Mitterbad.—*Switzerland:* Tharasp (Wyquelle).—*England:* Cheltenham, Tunbridge Wells.

America (*United States*), *California:* Geyser Spa, Sonoma Co.; Napa Soda Spring, Napa Co.; Pacific Congress Spring; Summit Spring, Alpine Co.—*Illinois:* Schuyler County Spring, Schuyler Co.—*Indiana:* Greencastle Spring, Putnam Co.—*Michigan:* Owosso Springs, Shiawasse Co.—*Mississippi:* Cooper's Well, Hinds Co.; Ocean Springs, Jackson Co.—*New York:* Columbia Spring, Columbia Co.; Richfield Iron Spring, Otsego Co.; Sharon Chalybeate Spring, Schoharie Co.; Oak Orchard Spring, Genesee Co.—*Pennsylvania:* Cresson Springs, Cambria Co.; Fayette Springs, Fayette Co.; Kittanning Mineral Spring, Armstrong Co.—*Tennessee:* Montvale Spring, Blount Co.—*Texas:* Thorp's Spring, Hood Co.—*Virginia:* Augusta Springs, Augusta Co.; Bath Alum Spring, Bath Co.; Bedford Alum Spring, Bedford Co,; Jordan Alum Springs, Rockbridge Co.; Orkney Springs, Shenandoah Co; Rawley Springs, Rockingham Co.; Rockbridge Alum Springs, Rockbridge Co.; Sweet Chalybeate Spring, Alleghany Co.—*West Virginia:* Fauquier's White Sulphur Spring, Fauquier Co.—*Wisconsin:* Sparta Artesian Well, Monroe Co.

Acidulous Waters.

These waters owe their therapeutic properties to the large quantity of carbonic acid gas they contain, the solid constituents being present in only small amounts. As has been already stated, many alkaline and saline waters contain considerable quantities of this gas, but its effects, whatever they may be, are completely overshadowed by those of the mineral ingredients. In the acidulous waters, however, the carbonic dioxide is the chief therapeutic agent, and for this reason it becomes necessary to discuss them as a separate class of mineral waters.

The physiological action of carbonated waters is comprised in a gentle stimulant effect upon the mucous membrane of the stomach,

promoting peristalsis, and thereby a more rapid evacuation of its contents. The pulse and respiration are said to be slightly accelerated, and a larger quantity of urine is excreted. It seems however, that this diuretic effect is not attributable to the carbonic acid gas, as is assumed by some authors, but rather to the large quantities of water which the patient is able to imbibe without distress, for the quantity of the gas absorbed into the blood through the walls of the stomach is certainly too small to produce systemic effects.

The acidulous waters have been chiefly recommended in gastric disorders, especially those of neurotic origin, and owing to their agreeable taste they form excellent table waters. They relieve nausea, increase the appetite, and aid digestion. They have also been employed as baths on account of their stimulating effect upon the peripheral nervous system.

The following are examples of this class of waters:

Europe, Germany: Brückenau (Wernazer Quelle), Apollinarisbrunnen, Charlottenbrunnen, Neuenahr (Augustaquelle), Rienerz (Kalte Quelle), Schwalbach (Lindenbrunnen), Wildungen (Georg-Victorquelle).—*Bohemia:* Karlsbad (Dorotheenquelle), Liebwerda, Marienbad (Karolinenbrunnen).—*Styria:* Gleichenberg (Klausenquelle).

America, United States: Bladon Vichy Springs, Choctaw Co., Alabama; Blue Lick Spring, Maysville, Kentucky; Summit Soda Springs, Alpine Co., California; Sweet Chalybeate Spring, Alleghany Co., and Sweet Springs, Monroe Co., West Virginia; Clysmic Spring, Waukesha, Wisconsin.

Calcareous Waters.

These waters contain the sulphate and carbonate of calcium and the carbonate of magnesium, the calcium being the prominent constituent. They occur as cold and as thermal springs, and are frequently charged with carbonic acid gas. In a therapeutic sense they are of doubtful utility, and many authorities refuse them recognition as mineral waters. Although nothing is known of their physiological action, they have been highly recommended by Macpherson and others in gout, rheumatism, cystitis, uric-acid concretions, dyspepsia, chronic diarrhœa, etc. A number of characteristic waters of this class are given in the following list:

Europe, France: Contrexéville, Ussa, Vittel.—*Germany:* Wildungen, Driburg.—*Switzerland:* Vals, Weissenburg, Muri.—*England:* Bristol, Bath.—*Hungary:* Borszek, Szliacs.

America (*United States*), *Michigan:* Butterworth Springs, Kent Co.; Eaton, Rapid Wells, Eaton Co.; Leslie Well, Ingham Co.—*Ohio:* Yellow Springs, Greene Co.—*Pennsylvania:* Gettysburg Springs, Adams Co.—*Vermont:* Clarendon Springs, Rutland Co.—*Virginia:*

Alleghany Springs, Monroe Co.; Berkely Springs, Morgan Co.; Bethesda Springs.

Thermal Waters.

These waters owe their medicinal properties to their elevated temperature, which varies from 85° F. to the boiling-point. Owing to the considerable proportion of mineral and gaseous constituents contained in some of them, they have been mentioned among the other classes: the majority of these waters are, however, deficient in solids, and aside from their high temperature may be regarded as therapeutically indifferent. They have been chiefly utilized for baths and recommended in the treatment of chronic rheumatism, gout, neuralgia, paralysis, chronic diseases of the skin, and syphilis. In all these diseases their effect differs in no essential degree from that of artificially heated water. It has been claimed that the continuous and uniform temperature of mineral baths constitutes an element of superiority over the domestic baths; but this factor is certainly of slight importance, and probably the environment contributes essentially to the curative effects of thermal springs, as it does in the otheral mineral waters.

Below is given a list of thermal springs in Europe and America:

Europe, Germany: Aix-la-Chapelle (Kaiserquelle, 131° F.); Baden-Baden (Hauptquelle, 155.4° F.); Ems (Kesselbrunnen, 118.4°; Neuebadequelle, 122°); Karlsbad (Mühlbrunnen, 136° F.; Sprudel, 164.8° F.; Schlorsbrunnen, 134.4° F.); Neuenahr (Mariensprudel, 101.75° F.); Schlangenbad, 82.4°–89.6° F.; Warmbrunn, 104° F.; Wiesbaden, 155.6°; Wildbad, 94° F.—*France:* Aix-les-bains, 110.3°; Amèlie-les-bains, 141.8° F.; Bagnères de Luchon, 131.3° F.; Balaruc, 118.4° F.; Barèges, 111° F.; Dax, 140° F.; Mont Doré, 105.8° F.; Neris, 129° F.—*Italy:* Battaglia, 160° F.—*Austro-Hungary:* Baden, 96.8°; Gastein, 87°–160° F.; Grosswardein, 113° F.; Harkany, 144.5° F.; Töplitz (Hauptquelle, 120° F.); Warasdin-Töplitz, 134.6° F.—*Switzerland:* Leuk, 123° F.; Ragaz, 95° F.—*England:* Bath, 116.6° F.

America (United States): Arkansas: Hot Springs, Garland Co., 93°–150° F.—*California:* Calistoga Hot Springs, Napa Co., 100°–195° F.; Paso Robles Hot Sulphur Springs, Obispo Co. (Main Spring, 112° F.; Mud Spring, 122° F.); Santa Barbara Hot Sulphur Springs, Santa Barbara Co., 60°–130° F.—*Colorado:* Bath Spring, 103° F.; Chalk Creek Hot Springs, 130° F.; Hot Springs, Fremont Co., 95°–102° F.; Idaho Warm Spring, Clear Creek Co., 85°–115° F.; Middle Park Hot Sulphur Springs, Summit Co., 116° F.—*Georgia:* Warm Springs, Merriwether Co., 90° F.—*Idaho:* Hot Springs, near Boisé City, 196° F.—*Nevada:* Hot Springs, near Pyramid Lake, 208° F.—*New Mexico:* Hot Springs, Las Vegas Co., 123°–130° F.—*North*

Carolina: Warm Springs, Madison Co. (Bathing Spring, 102° F.; Drinking Spring, 97° F.).—*Oregon:* Des Chutes Hot Springs, Wasco Co., 143°–145° F.; Malhuer River Springs, Baker Co., 193° F.—*South Carolina:* Charleston Artesian Well, 87° F.—*Virginia:* Healing Spring, Bath Co. (Old Spring, 85° F.; New Spring, 88° F.); Hot Springs, Bath Co. (Ladies' Boiler Bath, 110° F.; Ladies Sulphur Bath, 102° F.; Gentlemen's Pleasure Bath, 78° F.); Warm Springs, Bath Co., 96°–98° F.

GENERAL SANITATION.

By HENRY B. BAKER, A. M., M. D.

Recently there has been great progress in several sciences contributory to sanitary science—that science which forms the basis for intelligent and successful public-health administration. This is especially true of those biological sciences which deal with the microscopic causes of diseases. There has been progress also in knowledge gained through mortality statistics, heretofore the main basis for practical sanitation. In one or two localities advances have been made through sickness statistics. But progress has been made in other lines of accurate knowledge concerning the causation, modes of spreading, and measures effective for the prevention and restriction of diseases.

Much of this advance is a result of extensions and outgrowths of the medical sciences. The sanitary sciences are largely advanced medical sciences, and require for their complete mastery a well-grounded knowledge of medical science. Therefore, although not all physicians may wish to enter the public service as sanitary officials, leading sanitary officials must generally be physicians.

Owing partly to the rapid increase of knowlege useful for the prevention of disease, the numbers of sanitary officials are rapidly increasing, and in the immediate future they should still more rapidly increase. This field of labor is a very attractive one, for several reasons: the studies are intensely interesting, leading as they do into new fields of scientific investigation, and yielding knowledge of such surpassing importance to mankind. The fame of a Jenner, a Pasteur, or a Koch may not be gained by every investigator in such fields, but whoever does successful work in such directions merits, and is likely to receive, the homage of grateful humanity in whose behalf the work is done.

From a social-science standpoint the prevention of disease is much more economical than is its cure. Sooner or later the people generally will recognize this fact, and then there will be a general demand for sanitarians, and these should, in great part, be recruited from the ranks of medical practitioners.

Eminent men in the medical profession have prophesied that in the future the duties and labors of physicians generally will become more

largely preventive than curative of disease. While this may prove to be true, it would seem to be more in harmony with the general laws of progress that there should first occur a division of labor—a separation of the profession into specialties, one portion being devoted to preventive, and other portions to the several branches of curative, treatment. It seems to be admitted, however, that a broad culture in all of the medical sciences supplies a good basis for the training of a specialist in any branch of medical practice; and preventive measures are expected to apply to every disease treated by any specialist. The general good of mankind therefore calls for an interest in, and some knowledge of, sanitary science and its practical application in public-health work on the part of every physician.

The purpose of this essay is to give a general view, such as every physician should have, of the essentials in applied sanitary science.

The Evidence that Sickness and Deaths can be Prevented.—The evidence is of several kinds, and is entirely conclusive. There is not room for all of it here, but some of it may be referred to, as follows:

1. It is well known that, coincident with the generally improving sanitary conditions, there has been a gradual increase in the average duration of human life throughout the past history of civilized man.

2. A few hundred years ago leprosy was a common disease in Great Britain; the map of England was dotted over with leper hospitals. Apparently through even such imperfect isolation as was practised leprosy decreased until now it is a very rare disease in that country.

3. Not many years ago scurvy was a very common disease. Its causes became known, preventive methods were adopted, and now it is a rare disease.

4. In many countries, through drainage of the soil, clearing of forests, and other measures tending to reduce the difference between the day and the night atmospheric temperature, there has been a very great reduction of the sickness from intermittent fevers.

5. In many countries, apparently through better conditions of living, better housing, drainage, foods, etc., there has been a reduction of the mortality from consumption, as shown by the vital statistics.

6. In some countries the reduction of the mortality from consumption has followed or was coincident with measures, such as drainage, etc., which tended to make a drier, and consequently a warmer, soil about residences. This was proved by Dr. Henry I. Bowditch in Massachusetts and by Dr. Buchanan in England. Dr. Pepper's work in Pennsylvania may also be mentioned in this connection. But so long as the most important cause of consumption remained unknown, the most important measures for its prevention could not be adopted. Now that this is known, and is coming to be generally accepted, the

general prevention of consumption seems to be practicable. All the measures that in the past have been proved to be effective should be continued, and the additional measures which are now apparent through the important discovery of the specific cause of the disease should be promptly adopted. What those measures are will be dwelt upon farther on in this article.

7. The present comparative immunity from the plague, the black death, and the sweating sickness, indicates the effectiveness of the preventive measures which have been adopted.

8. The wonderful reduction of the mortality from smallpox which has followed the methods established by Jenner is well known.

9. The comparative recent immunity from cholera in this country is probably due to improved measures for the prevention of its introduction and spreading in this country.

10. The comparative recent immunity from yellow fever in some of the Southern States of this Union is probably due to the improved quarantines at New Orleans and other ports, and to sanitary measures, such as those inaugurated in Memphis, Tenn., by the National Board of Health and since maintained and added to by intelligent citizens of Memphis.

11. One of the most remarkable instances of the recent almost complete local extinction of a disease through sanitary measures is that of typhoid fever in Munich, Bavaria, described farther on in this article.

12. The record of the great saving of human life and health in Michigan in recent years is one to which the State and local boards of health in Michigan can justly point with pride. It is a record of the saving of over one hundred lives per year from smallpox, four hundred lives per year saved from death by scarlet fever, and nearly six hundred lives per year saved from death by diphtheria—an aggregate of eleven hundred lives per year, or three lives per day, saved from these three diseases.[1]

Diseases which are Preventable.—A long list can now be made of diseases which in times past swept people off the earth, but which are no longer to be feared: they are demonstrated to have been "preventable" diseases.

There can now be made a list of important diseases which have been restricted or prevented over such a considerable area or in so many localities that there can be little if any doubt that they are "preventable" diseases. Such a list would include smallpox, cholera, yellow fever, scarlet fever, and diphtheria.

[1] In a carefully-prepared paper, read before the Sanitary Convention at Vicksburg, Michigan, the proceedings of which are published by the Michigan State Board of Health, the author gave official statistics and evidence which he thus summarized.

It is apparent that the diseases which first came under the control of man were those which were most noticeably communicable. Isolation of the infected persons and things and crude methods of disinfection were practised far back in the dim past. Such methods were sufficient to do away with some diseases. More careful and skilful application of those same methods have sufficed to restrict some of the most important diseases of the present time. Thus, it has been demonstrated that by isolation and disinfection, by such methods as was recommended by a State board of health, scarlet fever and diphtheria have been restricted, so that at least four-fifths of the cases and deaths which would otherwise occur have been prevented.[1]

It is apparent that those communicable diseases which, like tuberculosis and diphtheria, were not recognized as communicable, would not be brought under control. That seems to be the reason why to-day, throughout the world, consumption is the cause of more deaths than is any other disease. But the history of sanitation in the past would seem to guarantee that as soon as the modes of its spreading are generally known that disease will decline, as many such diseases in times past have declined, leprosy being the disease most comparable to tuberculosis. The history of smallpox may throw doubt on this promise, because until vaccination was discovered and adopted the disease was not prevented or materially restricted. Yet it is now claimed that the human race is intelligent enough to restrict smallpox by isolation and disinfection without the aid of vaccination. Vaccination has been demonstrated to be so useful and so harmless a measure that it is to be hoped that, until boards of health are much better supported than they have been, no such dangerous experiment will be tried, over a very considerable proportion of the world's inhabitants, as would be the general neglect of vaccination. But, granting that smallpox was prevented only through vaccination, it does not seem too much to expect that tubercular diseases will in some way soon become rare. Such accurate knowledge of the subject as we now possess should enable us to restrict almost entirely all diseases due to the *Bacillus tuberculosis*.

Theoretically, all specific diseases should be considered to be preventable, and, theoretically, all dietetic diseases, such as scurvy and alcoholism, should be considered in the same category. Man's control over such influences as atmospheric temperature should soon be sufficient to enable him to prevent diseases due to such conditions. Finally, all diseases which cause premature deaths should be considered to be preventable, and efforts should be made to gain such knowledge of their causation as will enable man to adopt the proper measures for their prevention.

[1] This is mentioned farther on, in connection with evidence on the subject (Figs. 145 and 146).

The Creation of Sanitary Science necessarily a Governmental Function.—Among the most important bases for practical sanitation are morbility statistics, mortality statistics, and tabulated records of experience in sanitation. Neither of these three important bases can be supplied by individual effort. For the recording, collecting, tabulating, and publishing of such data legal provision is essential; and if the work stops here, it will, as a rule, fail to reach a useful stage. It is needful that there shall be governmental recording, collecting, tabulating, and publishing of the conditions of the atmosphere and of other agencies controlling the causation of diseases; and before such knowledge is available for practical usefulness there must be a bringing together, comparison, and study of the results of these several groups of facts in ways to show conclusively the relations which meteorological and other conditions sustain to each of the important diseases. The causation of diseases cannot otherwise be learned, and without a knowledge of the causation of a disease efforts for its prevention are futile. General sanitation requires, first of all, then, legal provision for systematic governmental action for continuous morbility statistics, mortality statistics, and records of experience in sanitation.

The practical application of sanitary science has two closely-related objects: the prevention of premature deaths and the prevention of unnecessary sickness. It does not follow that the most sickness and the most deaths are both from the same disease; and in some parts of this country the most sickness results from a disease which causes few deaths.

Morbility Statistics.—The relative importance of the various diseases as causes of sickness can be learned in only a few States or cities in this country. It can be learned so far as relates to the regular armies in most countries. Sickness statistics are very valuable for many purposes, and especially for comparison with statistics of meteorological and other conditions for the purpose of learning the causation of diseases.

In Michigan, under the direction of the State Board of Health, there is a system of scientific collective investigation of disease whereby, through weekly reports of the sickness under their personal observation, leading physicians throughout the State supply data which for many years have been tabulated and graphic curves drawn, so as to exhibit plainly the relations which about all the most important diseases sustain to nearly all of the most important meteorological conditions. This illustrates how it is possible to learn the conditions under which each of the various diseases increases, and those under which each disease declines, in prevalence. Such knowledge is essential to any complete system of general sanitation. It seems almost past comprehension that, in this country, in this enlightened age, such work has been systematically done in only one State.

Mortality Statistics.—It is obvious that without mortality statistics sanitarians would be "in the dark" as regards knowledge of progress, lack of progress, or the special direction of most need for effort. This is not a treatise on vital statistics, and little need be said on this subject here, but every physician is interested in having a fair idea of the condition of health in his own city or locality and in comparing States and localities. In order to make such comparisons one must be sufficiently familiar with the methods of statisticians to be able to interpret their mortality reports; and, owing to the diversity of methods, this is sometimes quite difficult. Some of the most usual methods are here mentioned.

Relative to a given disease the death-rate is sometimes stated by the hundred, thousand, ten thousand, one hundred thousand, or million living inhabitants of the city, state, or country; but the most usual method is per ten thousand inhabitants living at the middle of the year.

The death-rate from all causes is generally stated per one thousand inhabitants per annum. And this is the rule for mortality statistics published each month or each week. It is important that such a rule be generally adopted, so that at a glance one can see how the death-rate in any given city, in any given week or month, compares with that in other cities, with that in the other weeks or months in the year, and with the annual rate. Many intelligent people, however, fail to read the death-rate correctly when it is correctly stated. If for a given week or month the death-rate is stated as "22 per thousand per annum," what is meant is that if the same rate as prevailed in that week or month were to prevail throughout the entire year, the death-rate would be 22 per thousand inhabitants living at the middle of the year.

In this country there is not exact uniformity in methods of stating, or even in methods of computing, the death-rate, each health officer or statistician feeling at liberty to employ his own method. In the office of the Registrar-General of England—and probably also throughout England—in obtaining the death-rate for a given week the practice is said to be about as follows: "Divide the actual population by 52.17747—the number of weeks in the exact year[1]—and with the quotient thus obtained divide the product of the actual weekly deaths multiplied by one thousand." Perhaps the subject would be better understood by some persons if the formula were differently stated, as, for instance: Multiply 52.17747—the weeks in the year—by the actual deaths during the week, and divide the product by the number of thousands of inhabitants.

Where the statement of the death-rate is for a month, the formula might be: Divide 365.24226 by the number of days in that month,

[1] The exact year being 365.24226 days.

multiply the quotient by the number of deaths, and divide the result by the number of thousands of inhabitants.

The Principal Causes of Deaths.—The answer to this question is not the same in every State in this Union. Thus, in Michigan the five diseases which cause the most deaths, arranged in order by numbers of deaths, are—consumption, diphtheria, pneumonia, typhoid fever, scarlet fever. In Memphis, Tennessee, judging from the statistics for the year 1889, consumption causes the most deaths, and pneumonia next; but malarial fever is fourth on the list, and should really be considered third as a cause of mortality.

Some idea of the importance of the practical application of sanitary science to the prevention of disease may be seen in the fact that each one of the five diseases which cause the largest number of deaths in Michigan is believed to be a preventable disease, and, excepting pneumonia, about which there may still be doubt, the practical measures for their restriction and prevention are already quite well known to leading sanitarians. There are also several other important diseases for the prevention of which effective methods are known.

The Prevention of our Present Most Important Diseases necessarily a Governmental Function. — Private or personal hygiene is good, but it is entirely inadequate to prevent any of those diseases which now cause most deaths. It is probably useful, but not effective, against consumption; of very little use against diphtheria or scarlet fever; useful, but not protective, against pneumonia and typhoid fever. For protection against the dangerous communicable diseases the general co-operation of all classes of people is essential. Each person is so continuously exposed, directly and indirectly, to other persons in all ranks of life that no person can live to himself alone; the safety of each is bound up with the safety of others, so that each individual has a vital interest in the general health and in general and special measures for the safety of the public health. The public health, then, must be guarded by public officials. Disraeli said: "The health of the people is the first duty of the statesman."

In organization and methods the public-health service should, in my opinion, conform to the organization and methods for other governmental purposes. In this country, where the people rule, the principle of local self-government is important for purposes of public sanitation. There can be no such thorough co-operation as is required among all classes of people unless all classes of people appreciate the importance of such action; and they cannot appreciate the importance of such action unless they are informed on the subject. For progress in general sanitation it is essential that information on the subject shall be general, and that the general information shall be sufficient to enable the people to appreciate the work of the local health officer.

Wherever practicable, as in townships, villages, and small cities, it is desirable that the same local officers who control the appropriations of money shall be the local board of health, or at least shall be in such relation to the board of health that they shall become familiar with its needs. Otherwise, the health service will generally be crippled for lack of money to do what is needed to be done. If the officers who control the money are the same to whom the people look for proper public-health work, they will, as a rule, be more likely to provide sufficient money to carry on the work. In townships the township board or other officials who control the township affairs should be the board of health. But this board of health should have a health officer, who, wherever this is practicable, should be a physician. In villages the board of trustees, board of aldermen, or whatever the village board may be called, should be the board of health if no other board of experts is actually organized. In cities there should be a special board of health, composed of sanitarians, or at least of physicians or professional men, with an expert sanitarian for health officer.

The general co-operation of citizens for the prevention of disease should be required by law: notification of the occurrence of a dangerous communicable disease should be compulsory upon every householder, the notice to be given to the health officer, and it should be required to be given nearly as promptly as is the ordinary alarm of fire, because the danger is to life, whereas in the case of fire it is more frequently only to property.

The health officer should have ample authority, force, and means, and the law should require him, under penalty, promptly to enforce strict isolation of all known infected persons and things; to give notice of every known infected place to all concerned, by a placard on the infected premises, and otherwise when necessary; to control and supervise any and all movements of infected persons and things; to allow no public or other vehicle used for transporting infected persons or things to be used again except after thorough disinfection; to have all infected premises disinfected before permitting their occupancy by uninfected persons; to control all funerals and burials of persons dead from any cause.

These methods are applicable for the restriction of smallpox, diphtheria, scarlet fever, and perhaps other diseases. For the restriction and for the prevention of other diseases other measures are important, which may be briefly mentioned here, and at greater length elsewhere.

For the prevention of smallpox the most important measure is vaccination and revaccination. For the prevention of typhoid fever a proper sewerage and water-supply are important.

The construction of buildings should be under expert supervision

as to ventilation, heating, lighting, house-drainage, etc. The water-supply should be under expert supervision as to source, etc., and from time to time be examined chemically and biologically. For the prevention of consumption, that most important of all diseases, there should be not only destruction or disinfection of all sputa, but expert supervision of sites for buildings, drainage of sites, ventilation of dwellings, and especially of all public buildings. For the prevention of rheumatism hygiene is useful, but there is need for the general instruction of all classes of people as to its causation, the proper diet, and prevention of exposure. For the prevention of neuralgia similar instruction is needed. Systematic records of sickness from rheumatism, tonsillitis, neuralgia, and similar troubles, and of coincident conditions, conjoined with advances in pathology, now make it possible for sanitarians to give such instruction. But such knowledge has not been, and probably will not be, collected and elaborated by local boards of health. The collection and the dissemination of such knowledge are, more properly, functions of the State board of health.

State Boards of Health.—The proper organization of the public-health service requires the co-ordination of the work of all local boards of health, through the agencies of State and National boards of health.

The State board of health is preferable to the State health officer or commissioner of health, for several reasons, one of which is as follows: A State health officer or commissioner of health must be, almost necessarily, a political officer, subject to frequent change at the dictation of party interests. No such officer would be likely to remain in office long enough to become thoroughly conversant with the varied duties of chief executive officer of health.

The chief executive officer of health for a State should be—what no man can become except through long-continued study and experience—an expert in the several branches of sanitary science and in public-health administration. He should be a sanitarian and also a social scientist. He should also be thoroughly conversant with all laws of his State relating to measures needed to be employed in the public-health service. He should be an expert statistician. He should be a thorough meteorologist. He should be especially skilled in those sciences which contribute to a knowledge of the etiology of diseases. He should be a well-educated physician, with special talents for scientific studies and investigations. He should have considerable knowledge of the physical sciences, especially of chemistry.

The requirements for the position are so extraordinary that few persons in other pursuits could be expected to fulfil them at once and without experience. Since experience is so important, measures for ensuring freedom from change for political reasons, and permanency of position so long as the duties of the office are properly performed, are

correspondingly important. Permanency of position during proper performance of duty should be provided for by a law that shall so declare. But even a law to that effect can be strengthened by providing as near as may be a non-partisan board of health, whose members shall be the judges whether the chief executive officer of health is faithfully performing the duties of his office. And the members of such a board, consisting of the leading sanitarians of the State, are better qualified to select, in the first instance, the person who is likely to prove an efficient executive officer than would usually be the governor and senate of a State. A State board of health is therefore an important agency for securing and for maintaining for the State a proper chief executive officer of health. This is only one of many reasons for the existence of a State board of health, but it would seem to be a sufficient reason; and, to the writer, the other reasons are even more evident and apparent. The stability of the State board is increased if the terms of office of its members are long and do not all expire at the same time. If there are six members, the terms may be seven years, two members retiring every two years. But with members of the board, as with the chief executive, experience is valuable, and the reappointment of faithful members is desirable, although without that, if a majority of the board continue in office, something like continuity and permanency is attained.

Old and New Views of General Sanitation.—There was a time when the most enlightened public view of the subject of general sanitation included not much more than the abatement of nuisances and the restriction of smallpox. Indeed, at the present time one great hindrance to progress in general sanitation is the inertia in the minds of the people, due to this same old idea. Too generally the functions of a board of health or of a health officer are supposed to be the abatement of such nuisances as powerfully appeal to the sense of smell, sight, or hearing. We know, however, that the important diseases which are spread by ordinary filth are few compared with those which are spread by particulate "specific" causes which cannot be recognized by any of the senses unaided. The specific causes of some of the most dangerous diseases have no odor. They are not visible, except through the aid of the microscope or of some special method of cultivation. Sanitarians have learned the causes of "the pestilence which walketh in darkness and wasteth by noonday," and are able to set forth to the people methods which will undoubtedly be effective for the prevention of the "pestilence" (tuberculosis) that causes more deaths than any other, and of several other pestilences which, like diphtheria and scarlet fever, rank only a little below that great white plague. There is, therefore, need no longer for being so exceedingly "afraid of the dark," as may be termed that fear of filth which has been so general. Not

that filth does not cause disease: it may do so; at least there are diseases which, if they are not caused by filth, are so intimately associated with it that an enlightened avoidance of filth is preventive of the disease. This is true of cholera and of typhoid fever, and probably true of yellow fever.[1]

One of the most graphic exhibits of the relations of filth to cholera and to typhoid fever is that prepared by Dr. Joseph von Fodor of Buda-pesth, who tabulated the results of his investigations and study of the subject in Buda-pesth for a period of fifteen years (1863–1877), as follows:[2]

Typhoid Fever and Cholera in Buda-pesth, 1863–77.

1. *Influence of filthy houses:*		
Deaths from cholera per 100 houses when the interior of the dwelling was	1. Very clean	92
	2. Clean	199
	3. Dirty	268
	4. Very dirty	402
Deaths from typhoid fever per 100 houses when the interior of the dwelling was	1. Very clean	165
	2. Clean	177
	3. Dirty	182
	4. Very dirty	356
2. *Influence of filthy yards:*		
Cholera deaths per 100 houses when the yard was	1. Very clean	188
	2. Clean	214
	3. Dirty	263
	4. Very dirty	389
Typhoid-fever deaths per 100 houses when the yard was	1. Very clean	159
	2. Clean	186
	3. Dirty	208
	4. Very dirty	282

Yet even cholera is not with certainty prevented by such action as results from a blind fear of filth. Knowledge of the specific cause of the disease and of its conditions of reproduction and destruction is useful for teaching the best measures for the prevention of cholera, the most important measure being the destruction or disinfection of the specific micro-organism which causes cholera. This "most important measure," disinfection, is to be treated separately and thoroughly in this volume by Dr. Sternberg; therefore it is not necessary to give details here, and we may pass on with the general principles of sanitation.

Cleanliness "Next to Godliness" in Sanitation.—A terse phrase is useful whenever it strongly presents a great truth. It may, however, become a great hindrance to progress when it conveys strongly an idea which falls far short of the truth. The phrase "cleanliness is next

[1] If it were not for accidental inoculations, tetanus also might be included in this statement, because the specific cause of tetanus is so frequently associated with dirt about stables and with garden soil.

[2] "Ueber den Einfluss der Wohnungensverhältnisse auf die Verbreitung von Cholera und Typhus," *Archiv für Hygiene*, 1884, Seite 269.

to godliness" has long been used to convey an idea that ordinary cleanliness, as the term is commonly understood, is the end and aim, the sum and substance, of sanitation. The idea, thus conveyed, was once held by some of the leaders in sanitary affairs, but it is now known to be false, and for several years it has stood in the way of progress. The only way whereby it can be held to be still true is by greatly modifying our views of what constitutes cleanliness. I have endeavored to illustrate this as follows: "The housewife has one standard of cleanliness, which requires that a dish for the table must be thoroughly washed with soap in hot water, rinsed with clear water, and drained or wiped dry with a clean cloth. If such a clean dish be given to the chemist for his most accurate work, he may object that the dish is not chemically clean, and he will rinse it in alcohol or in a strong acid or a strong alkali, according to the particular form of matter which he fears makes it unclean for his purposes, and after rinsing and wiping or drying it he also will pronounce it clean. If this same dish, which has been made clean enough for the chemist, be given to the biologist who is experimenting on the vitality or reproduction of bacteria, he will pronounce it unclean for his purposes, and he will not be satisfied until he has submitted it to boiling water for at least five minutes or in dry air to a temperature of 240° or 250° F., and then he will require that it shall not be exposed for an instant to the ordinary air, for fear of its contamination by germs which sometimes float in the air. He will insist on these conditions because he has found by experience that ordinary cloths, ordinary air, and ordinary water generally contain bacteria, spores, or germs capable of reproduction under favoring conditions, and sometimes contain germs capable of reproduction in the bodies of human beings and of causing such diseases as smallpox, scarlet fever, and diphtheria."[1]

It is plain that what ordinary persons know as a clean plate, a clean article of clothing direct from the laundry, a piece of new goods from the store, or any of the ordinary articles which we consider "clean," may have received, and may convey, the specific cause of any of the most dangerous diseases.

In modern sanitation a fundamental idea, which it is important that every person should grasp, is that the "germ theory of disease" is now established on a firm scientific foundation; and this supplies a scientific basis for modern sanitation.

What a Health Officer should Know.—In order to be an intelligent and efficient health officer a physician should have clear ideas of the nature of contagia, of the conditions of their existence and reproduction within and without the body, of their destruction (disinfection), and of the means by which they are disseminated. Inasmuch as the

[1] *Report Michigan Board of Health*, 1880, p. 121.

specific causes of diseases are invisible to the unaided eye, the sanitarian must have and cultivate that "scientific use of the imagination" which will enable him to follow the dissemination of the contagium of each of the most important diseases, whether it goes out with the excreta and leaches into wells from which drinking-water is obtained, or with the sputa, and eventually rises into the air with the dust from floors or is spread through the air with the desquamations from the skin. He should constantly be able to bring before him a mental image of each micro-organism believed to be the specific cause of an important disease. He must at least master the idea that these contagia are "particulate." One way to do this is to consider vaccine virus as a form of contagium in mass sufficient to be seen by the eye. "If we imagine this to be made up of minute granules of rounded outline, so minute that twenty thousand of them in line will be required to extend an inch in length, we shall have an idea which will aid the mind in following the course and spread of disease-germs of this nature. We can then easily understand how such disease-germs may be floated off by the air, carried in a veil, scarf, or handkerchief, be stored or conveyed in the clothing, beard, or hair, appear as dust in a room, be sent in a letter or a paper, be boxed up and transported to a distance, washed off in water, carried into a privy, pass through the entire length of a sewer or the water-pipes which supply pure water, go in the milk-can on its round from house to house, or with the delivery-man from the grocer, baker, market, or laundry. This may serve to give us an idea of some of the problems with which the sanitarian has to deal in connection with the restriction and prevention of communicable disease, and some idea of what a health officer should know."

The Causation of Inflammations.—Recent advances in surgery, through practices originally based upon the "germ theory of disease," the methods being at first denominated "antiseptic surgery," and now "aseptic surgery," have led to a broadening of our view of the causes of inflammations. In addition to the causes of inflammations formerly dwelt upon, it seems to be established that there must be included certain micro-organisms which are very widely distributed in all thickly-settled communities—micrococci, sometimes grouped by twos and in chains—the *Streptococcus* or the *Staphylococcus pyogenes*, of which there are three varieties, the *albus*, *aureus*, and *citreus*, giving rise respectively to the white, the yellow, and the green pus. It is claimed that if these be kept out of wounds pus does not form, inflammation does not occur, and the wounds heal.

Sanitation in surgical hospitals must take account of the recent advances; and here also cleanliness is important, but simply that of the past is not fully adequate: there is required such knowledge of

the sources and the nature of the micro-organisms, the conditions of their vitality and of their destruction, as will make it possible to guard against them.

Through complete disinfection of walls, floors, and contents of hospitals, including instruments, etc., and of the clothing and persons (especially the hands) of the operators, attendants, and visitors, it is now claimed that not only hospital gangrene and such inflammations as erysipelas may be prevented from attacking surgical patients, but all inflammations are prevented, provided the patient and the air-supply are not infected.

If, as is claimed, these micro-organisms are an important factor in nearly all inflammations, "aseptic" methods must be applicable to the prevention, not only of surgical inflammations, but traumatic inflammations, and, in fact, all inflammations, except possibly those inflammations due to such specific causes as the *Bacillus tuberculosis*, the *Bacillus diphtheriæ*, etc., in which cases it might be true that the ordinary pus-generating micro-organisms were without influence. It seems to be proved, however, that even in those most important diseases due to specific causes the pus-generating micro-organisms are important factors. Therefore, all measures for securing an aseptic atmosphere are important. These measures should include the destruction of all sputa, the disinfection of all pocket-handkerchiefs, and the special care of all suppurating surfaces on man and on animals. "Since nearly all suppurative inflammations are breeding-places for micro-organisms, which, when they gain entrance into another living body (or into another weak or injured spot in the same body), are capable of again starting the inflammatory process, therefore should not all purulent discharges and all pus which is accessible be destroyed or disinfected? Should not the aim be thus to restrict the spread, and eventually to stamp out, all inflammations?"[1]

How the Specific Causes of Diseases Enter the Body.

In order best to guard against the introduction of the specific cause of a disease it is needful to know the most usual mode of its entrance into the body. As regards the most important diseases this knowledge is now available. Future discoveries may change our views on some of the points, but, according to what is now known to the writer, the most usual modes of entrance are as follows:

Typhoid Fever.—The specific cause of the disease is reproduced in the intestine, and probably in other parts of the body, being found in the spleen and other organs. The characteristic lesion in the lower portion of the small intestine indicates, perhaps, in what part of the body the specific cause is most generally destructive of tissue. Prob-

[1] "Sanitation in 1890," *Trans. Am. Pub. Health Assoc.*, 1890.

ably it most frequently leaves the body with the discharges from the bowels. It has been suggested that the bacillus which causes typhoid fever is morphologically the same as a bacillus commonly inhabiting the large intestine of persons in health. If it is really the same, and its destructive and toxic powers, when it gains entrance into the small intestine, are due to the more favorable conditions there for its existence and to greater absorption of its ptomaïne, a good and sufficient reason is found for the existence of the ileo-cæcal valve, also for the disinfection or safe disposition of all human excreta. Experiments are needed to prove whether the inhalation of the dust from dried human excreta from persons not having typhoid fever will cause typhoid fever. That typhoid fever is sometimes contracted by inhalation of the specific micro-organism seems to have been proved. If the usual method of disposal of human excreta should be changed from that of the water-carriage system or that of moist storage in vaults to that by drying and its conversion into dust, possibly the most usual mode of spread of typhoid fever might be changed. At the present time, however, the weight of the evidence is to the effect that typhoid fever is usually introduced into the body by way of the stomach and intestine. Drinking-water contaminated with fæcal discharges is believed to be the most common source or vehicle of typhoid fever. While the possibility of its originating in other ways is not denied, the frequent outbreaks of this disease which are traceable directly and unmistakably to a contaminated water-supply seem to point to this as the chief source of danger. The disease has also been traced to milk diluted with infected water, and apparently in some cases to emanations from sewers and cesspools. The well-known outbreak of typhoid fever at Plymouth, Pennsylvania, where over 1000 cases and 114 deaths occurred, is apparently an illustration of how great a calamity may follow the fouling of a *general* water-supply by the discharges of a person sick with typhoid fever.

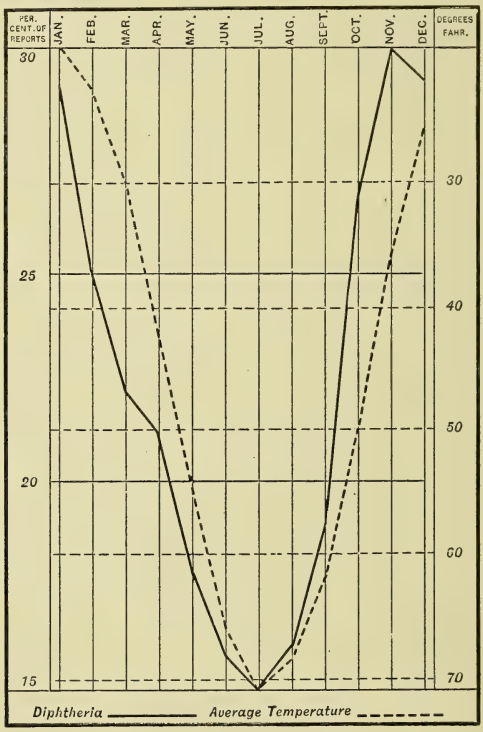
Diphtheria.—The specific cause of diphtheria (the Klebs-Löffler bacillus) may gain a lodgment on any part of the body where there is a broken surface, but ordinarily it does so in the throat. As a rule, it does not enter the general circulation in the human body; what enters is the poison evolved by the bacillus. The disease is most prevalent in the autumn and winter months, there being in Michigan twice as much sickness from it in November as there is in July. This indicates that exposure to the inhalation of a cold atmosphere increases the danger of contracting diphtheria; yet the disease does not sustain, by months, exact quantitative relations to the atmospheric temperature, the maximum sickness in Michigan occurring before the occurrence of the coldest weather. It is quite probable that the opening of the

schools in the autumn is a cause of an increase in diphtheria, so that its maximum amount is in November (Fig. 136).

FIG. 136.

SICKNESS FROM DIPHTHERIA, AND TEMPERATURE, IN MICHIGAN.

By months, for a period of nine years (1877–85), the relation of *Sickness* in Michigan from *Diphtheria*[1] to the *Average Atmospheric Temperature*. (The temperature curve is reversed; the scale increases downward.)



SCARLET FEVER.—We have not a thoroughly verified knowledge of the exact nature of the specific cause of scarlet fever, but we have much useful knowledge of its behavior. The specific cause of scarlet fever is probably reproduced in the throats of patients, and may be disseminated with the sputa; and, inasmuch as drying does not destroy the vitality of this contagium, the dust of the dried sputa should be considered dangerous. All the excreta should be disinfected. Apparently, however, the most common source of the contagion is in the desquamations from the skin of patients recovering from the disease, and the most common mode of entrance of the contagium into the body of the person who contracts scarlet fever is by inhalation of the particulate, specific cause, and lodgment and reproduction of the specific

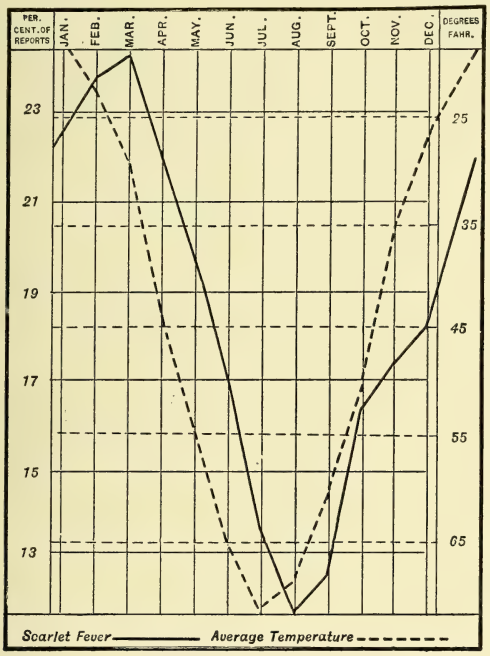
[1] Per cent. of reports which stated that diphtheria was under the observation of the physicians who made reports.

particles in the throat of the victim. If the foregoing is a correct outline of the usual methods of its dissemination, the disease, primarily, is local, a sore throat, but it is rapidly spread throughout the body. Fig. 137 shows that its maximum prevalence is after the coldest month, and its minimum after the warmest month.

FIG. 137.

TEMPERATURE AND SICKNESS FROM SCARLATINA, IN MICHIGAN.

By months, for a period of ten years (1877-86), the relation of *Sickness* from *Scarlet Fever*[1] in Michigan to the *Average Atmospheric Temperature.* (The temperature curve is reversed; the scale increases downward.)



Over 41,000 weekly reports of sickness and over 190,000 observations of the atmospheric temperature are represented in this diagram.

TUBERCULOSIS.—The *Bacillus tuberculosis* probably usually enters the body with the air inhaled, it being disseminated by the dust of dried sputa. Curves representing the amount of sickness and the number of deaths, by months, prove that consumption increases after the cold season of the year, and decreases in the warm season; as a rule, reaching its maximum in the spring and its minimum in summer or autumn (Fig. 138). Undoubtedly, the disease is sometimes contracted through the use of milk and meat of tuberculous animals, and occasionally through inoculation.

INFLAMMATORY RHEUMATISM.—The curve representing the rise

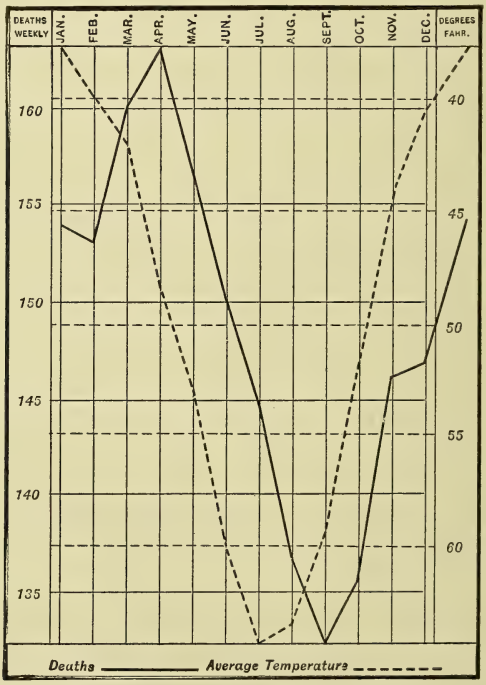
[1] Per cent. of reports which stated that scarlet fever was under the observation of the physicians who made reports.

and fall of rheumatism, by months, shows it to follow, with considerable regularity, the rise and fall of atmospheric temperature.[1] The curve for rheumatism follows the curve for tonsillitis. Clinical observers have noticed and recorded an apparent relationship between tonsillitis and rheumatism; and although most of them have concluded that the tonsillitis was rheumatic, the fact that usually tonsillitis precedes rheumatism seems to indicate that if there is a causal relation between the two diseases, tonsillitis is the most likely to stand as the first link in the chain. In tonsillitis and other inflammations of the

FIG. 138.

TEMPERATURE, AND DEATHS FROM PHTHISIS, IN LONDON.

By months, for a period of thirty years (1845–74), the relation of average *Deaths* per week, in London, England, from *Phthisis*, to the *Average Atmospheric Temperature*. (The temperature curve is reversed; the scale increases downward.)



About 231,000 deaths from Phthisis are represented in this diagram, data for which are from *Jour. of Scottish Med. Soc.*, New Series, Nos. xliii., xliv., xlv., xlvi., pp. 252 and 263.

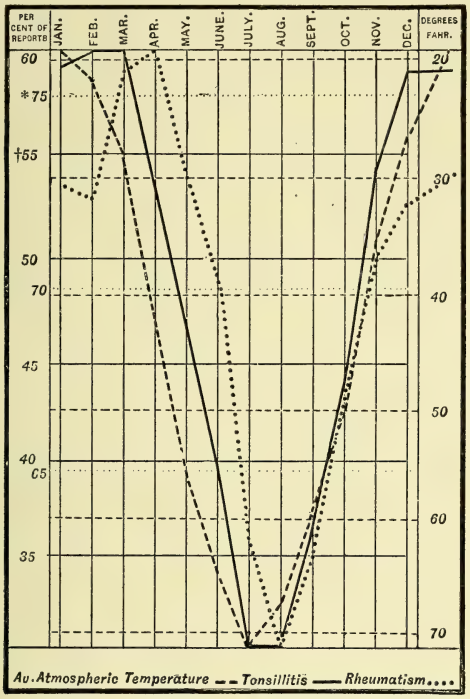
throat there is in the throat an increase in those same pus-generating micro-organisms which are found in inflammatory rheumatism; there is, therefore, increased opportunity for such micro-organisms to gain entrance to the body at times when sore throat prevails. So far as rheumatism is an inflammatory disease, its cause is probably generally introduced by way of the inflamed area in the throat or air-passages.

[1] This is shown by Fig. 139.

FIG. 139.

TONSILLITIS FOLLOWS TEMPERATURE; RHEUMATISM FOLLOWS TONSILLITIS.

By months, for a period of ten years (1879–88), the relation of *Sickness* in Michigan from *Tonsillitis* and *Rheumatism*[1] to the average *Atmospheric Temperature*, and the relation of Rheumatism to Tonsillitis. (The temperature curve is reversed; the scale increases downward.)



* Scale for rheumatism. † Scale for tonsillitis.

The Determining Cause of the Entrance of Specific Diseases into the Body.—It is useful to hold in mind the general principles relating to the entrance of specific causes of diseases into the human body:

1. A few diseases, such as smallpox, scarlet fever, and yellow fever, confer a considerable degree of immunity through their first attack.

2. Some degree of resistance to the successful entrance of specific diseases is the rule in all healthy human beings. This resistance is of at least two kinds: (*a*) the resistance of an unbroken surface; (*b*) the resistance of the normal tissues and fluids of the body, including the destructive power of the blood-serum on the microscopic causes of diseases.

3. Atmospheric temperature and other conditions of the atmosphere have, to a great extent, controlling influence over the entrance of most of the specific diseases. This fact, although not generally understood

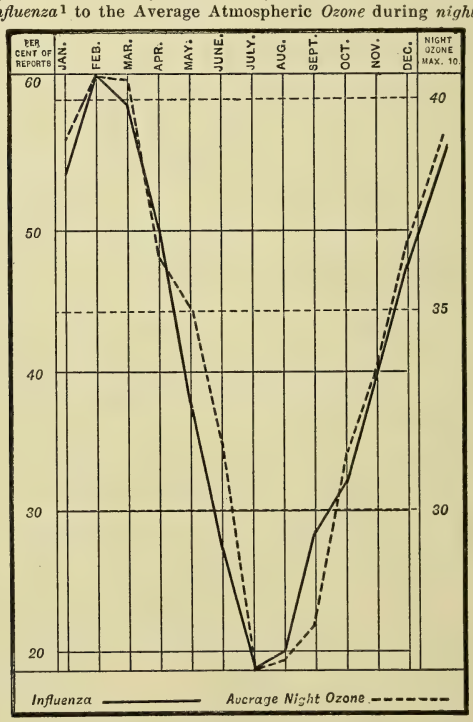
[1] Of all weekly reports received, the per cent. which stated that tonsillitis (or rheumatism) was under the observation of the physician reporting.

to be placed upon a scientific foundation, is popularly recognized. It is well known that diarrhœa is one of the "summer" complaints, and that coughs and colds occur most in cold weather. Recently the subject has been placed upon a scientific basis by reducing statements of facts relating to it to accurate statements of quantities—so much temperature or other meteorological conditions and so much sickness or so many deaths, as the case may be, from each important disease during a specified time. It has been found that most of the specific diseases sustain quantitative relations to atmospheric temperature, one class of diseases rising as the temperature rises, and another great class rising as the temperature falls. The changes in the sickness-rates and death-rates of some of the diseases lag behind the changes in the atmospheric conditions, just as they would be expected to do on account of the period of incubation and the duration of the disease. How closely

FIG. 140.

ATMOSPHERIC OZONE (NIGHT), AND SICKNESS FROM INFLUENZA, IN MICHIGAN.

By months, for a period of twelve years (1877–88), the relation of *Sickness* in Michigan from *Influenza*[1] to the Average Atmospheric *Ozone* during *nights*.



some of the diseases conform to the atmospheric conditions is shown by Figs. 136, 137, 138, 139, 140.

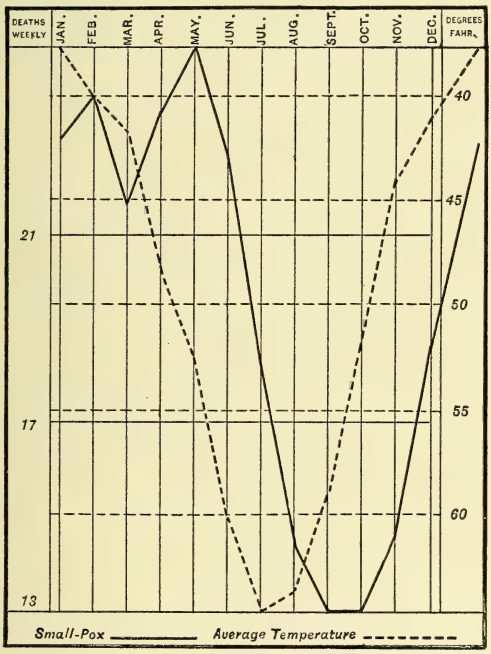
[1] Per cent. of reports which stated that influenza was under the observation of the physicians who made reports.

How it is that atmospheric conditions control to such an extent the entrance of specific diseases into the human body it is important should be understood, in order best to guard against their entrance. Probably the influences are complex, yet some of them seem to have been made apparent.[1] Simply lowering the temperature of the body is sufficient to cause some animals to contract a specific disease which otherwise is

FIG. 141.

TEMPERATURE, AND DEATHS FROM SMALLPOX, IN LONDON.

By months, for a period of thirty years (1845–74), the relation between the *Average Deaths from Smallpox* in London, England, and the *Average Atmospheric Temperature.* (The temperature curve is reversed; the scale increases downward.) Records of thirty thousand deaths are included in this diagram.



Except in a few months the smallpox changes follow two months after the temperature changes.

The line representing smallpox should follow as long a time later than a line representing its controlling condition as is the average duration of the fatal cases plus the period of incubation.

not contracted; thus Pasteur caused fowls to contract anthrax by causing the fowls, inoculated with anthrax, to stand in cold water. It is quite possible that raising the body temperature may be conducive to the contraction of some disease; but, as a rule, the warm-weather diseases seem to be due more to influences or absence of influences on the specific cause of the disease outside the body; thus it is alleged that the cause of yellow fever is destroyed by a "killing" frost.

[1] The writer has dealt with some of them in "The Causation of the Cold-Weather Diseases," *Annual Report Michigan State Board of Health,* 1887.

It should be generally known that, as a rule, all inflammatory diseases of the throat, air-passages, and lungs are increased by exposure to a cold atmosphere. The same is true of all specific diseases which generally enter the body by way of the throat, air-passages, or lungs (Figs. 136–141). On the contrary, diseases which generally enter the body by way of the mouth and alimentary canal increase during or following exposure in a warm atmosphere.

The Scientific Bases for Practical Sanitation.

Mortality Statistics.—Mortality statistics have supplied important bases for practical sanitation in several directions, one or two of which have already been suggested. The history of the prevention of smallpox through vaccination supplies one striking illustration. In the early years of vaccination the statistics included comparatively few instances of mortality influenced by this measure; yet even then the very great difference in the death-rates among vaccinated and unvaccinated persons was, to many physicians, conclusive evidence of the great value of vaccination as a sanitary measure. As time has passed the amount and strength of the evidence in this direction have been increasing, until now it cannot be doubted by any person of sound mind and ordinarily good reasoning powers who will carefully go over the evidence. Whoever wishes to investigate the subject thoroughly should have access to such evidence as that contained in "General Board of Health," *Papers relating to the History and Practice of Vaccination*, presented to both Houses of Parliament, and published in 1857; *Public-Health Reports*, John Simon, vol. i., published in London in 1887; and the *Report of the Royal Commission* on this subject, published in London in 1890. Vaccination began in England about the beginning of the present century. An idea of the immense importance of the subject may be gained by a simple statement of the statistics of the mortality-rate from smallpox in England at the close of the last century, and, by periods of years, since that time.

The average numbers of deaths from smallpox per annum, per million population, in England, at five periods of time, were as follows:

At the close of the eighteenth century	3000[1]
From 1841 to 1853	304
From 1854 to 1863 (compulsory vaccination since 1853)	171
From 1864 to 1877	251
From 1878 to 1887	54

In Sweden the average numbers of deaths from smallpox per annum, per million inhabitants, were—Before the introduction of

[1] Averages in the city of London were (Simon, *Public-Health Reports*, vol. i. p. 255): from 1681 to 1690, 3139; from 1746 to 1755, 3044.

vaccination (1774–1801), 1973; during the peried of optional vaccination (1802–16), 479; during the period of obligatory vaccination (1817–77), 189.

Such vital statistics need to be supplemented by statistics of mortality in recent times among the vaccinated and among unvaccinated persons, in order to make it certain that the very great reduction in the mortality from smallpox is not a result of sanitary measures other than vaccination. Such statistics it is quite practicable to obtain at hospitals where smallpox is treated. A study of such statistics of cases whereever and whenever recorded seems to show that smallpox when not modified by vaccination is still the same deadly disease that it was previous to this nineteenth century. (Tables A and C illustrate this, and also the fact that the amount of vaccination counts for much. These two tables are copied from the *First Report of the Royal Commission on Vaccination*, London, England, 1889, pp. 116 and 117. In Table C the columns have been rearranged.)

On the other hand, Dr. Marson, during forty-two years of duty as physician of the London Smallpox Hospital, has never observed a single case of smallpox in the officers and employés of the hospital, who are revaccinated when they enter the service, and who are constantly exposed to the infection.

TABLE A.

Statistical Evidence of the Different Degrees in which Persons Vaccinated in Different Ways will be Safe against Death by Smallpox if they should afterward Contract this Disease.

The table is founded (*a*) on information given in the 36th volume of the Medico-Chirurgical Society's *Transactions*, by Mr. Marson, surgeon of the Smallpox Hospital, as the result of his observations made during sixteen years, 1836–51, in 3094 cases of post-vaccinal smallpox; (*b*) on data derived from Mr. Marson's evidence before the Vaccination Committee of 1871, based on a further experience of 10,661 such cases, and covering also sixteen years, 1852–67.

Cases of Smallpox classified according to the Vaccination Marks borne by each Patient respectively.	Percentage of Deaths in each Class respectively; uncorrected.[1]		Percentage of Deaths in each Class respectively; corrected.[1]	
	1836-51.	1852-67.	1836-51.	1852-67.
1. Stated to have been vaccinated, but having no cicatrix	25.5	40.3	21.7	39.4
2. Having one vaccine cicatrix . .	9.2	14.8	7.6	13.8
3. Having two vaccine cicatrices .	6.0	8.7	4.3	7.7
4. Having three vaccine cicatrices.	3.6	3.7	1.8	3.0
5. Having four or more vaccine cicatrices	1.1	1.9	0.7	0.9
Unvaccinated	37.5	35.7	35.5	34.9

[1] The terms "uncorrected" and "corrected" are used to signify the inclusion or exclusion of those fatal cases of smallpox in which the patient suffered from some other disease superadded to the smallpox.

TABLE B.

Analysis of Dr. Gayton's 10,403 *Smallpox Cases, issued in* 1885. *Fatality per cent. of Attacks.*

At Ages.	Not Vaccinated.	Vaccination Nominal.[1]	1 Scar.		2 or 3 Scars.		4 or more Scars.		Total Good.	Total Imperfect.
			Good.	Imperfect.	Good.	Imperfect.	Good.	Imperfect.		
0–05	56.5	39.8	0.0	17.0	0.0	11.1	0.0	6.6	0.0	11.5
5–10	35.2	19.3	2.5	7.4	1.0	5.5	0.0	1.5	0.9	5.0
10–15	23.3	19.6	1.9	5.8	1.1	3.1	0.0	1.0	1.1	3.4
15–20	42.1	19.0	2.3	8.9	2.1	6.4	0.9	1.2	1.9	6.3
20–30	49.8	32.1	4.8	18.0	2.8	11.5	6.7	7.0	3.9	13.1
30–40	40.7	35.7	8.1	18.8	13.5	13.0	0.0	1.9	9.5	14.8
40–	43.0	33.5	1.4	19.6	13.0	18.7	0.0	1.8	12.5	19.1

Compulsory Vaccination.—The mortality statistics in England, in Sweden, and elsewhere prove that since compulsory vaccination was enforced the mortality from smallpox has been less than before. (Table C, relative to England and Wales, illustrates this statement.) This is particularly true where compulsory measures can best be enforced, as, for instance, in armies; and where revaccination is enforced prevention seems to be complete. Thus, in the Bavarian army, where revaccination was compulsory, there was not a single death from smallpox nor a case of unmodified smallpox from 1843 to 1857.

TABLE C.

Mean Annual Deaths from Smallpox [in England and Wales] at successive Life-periods, per Million living at such Life-period, 1847–53, 1854–71, and 1872–87.

Period.	All Ages.	0–5.	5–10.	10–15.	15–25.	25–45.	45 and Upward.
(1) Vaccination optional, 1847–53[2]	305	1617	337	94	109	66	22
(2) Vaccination obligatory, but not efficiently enforced, 1854–71	223	817	243	88	163	131	52
(3) Vaccination obligatory, but more efficiently enforced by vaccination officers, 1872–87	114	242	120	69	122	107	47

From the foregoing it must not be inferred that compulsory vaccination and compulsory revaccination are the best sanitary measures in all countries and at all times. It is certainly proved that vaccination and revaccination are the most important measures for the prevention of smallpox, and that in an army it is possible to obtain excellent

[1] "Nominal"—said to have been vaccinated, but no marks visible.

[2] In this table the period of optional vaccination begins with 1847, not with 1838, because the deaths were not abstracted in combination with ages until 1847.

[Table C is from page 114 of the *First Report of the Royal Commission appointed to Inquire into the Subject of Vaccination*, London, England, 1889.]

results through compulsory vaccination and revaccination; but the question whether the law should or should not require compulsory vaccination in the United States is still an open one. Some of the bases upon which a conclusion should rest may be indicated here.

Statistics of mortality from smallpox, such as those just mentioned, relative to England and Sweden before and since compulsory vaccination has been required by law, should be compared with statistics of mortality from smallpox in other countries where compulsory vaccination has not been required by law. Such statistics have not yet been much studied. As an example, but not as conclusive, the following table is taken from an article on this subject in the *Transactions of the Michigan State Medical Society:*[1]

TABLE D.

Exhibiting, for the Nineteen Years, and for each of the Nineteen Years, 1869–87, the Number of Reported Deaths from Smallpox per Million of Inhabitants in Michigan,[2] *in Comparison with the same for England.*[3]

Years.	England.	Michigan.	Years.	England.	Michigan.
1869	67	37	1881	[4]119	50
1870	113	8	1882	50	[4]57
1871	[4]1012	60	1883	36	3
1872	821	[4]240	1884	82	2
1873[5]	98	69	1885	[4]103	2
1874	88	13	1886	10	[4]3
1875	35	19	1887	18	0
1876	99	53			
1877	[4]173	[4]69	Av. 1869–87	160.2	36.6
1878	74	4	" 1869–77	278.4	63.1
1879	21	4	" 1878–87	53.8	12.7
1880	25	2			

In England they have had compulsory vaccination since 1853. In Michigan vaccination depends upon the enlightened self-interest of the people. It may be seen that the reported mortality from smallpox is about four times as great in England as it is in Michigan. This might be due to one cause or to several causes; for instance, it is possible that a larger proportion of the deaths from smallpox that occur are reported in England than in Michigan.

It may be a long time before we have a scientific basis for such action as compulsory vaccination, especially among a people who govern themselves. It is likely to be still longer before we shall have a scientific basis for a law for compulsory revaccination.

[1] 1890, p. 159.

[2] Compiled from the Vital Statistics of Michigan.

[3] Taken from the Fiftieth Annual Report of the Registrar-General of Births, Deaths, and Marriages in England (1887), London, 1888.

[4] Crest of an epidemic wave.

[5] The Michigan State Board of Health was established in 1873.

While waiting for statistical proof of the wisdom of compulsory vaccination in countries governed by the people, the subject would seem to be one which should be discussed by those skilled in social science.

Compulsory Vaccination of Children and Adults.—Sir John Simon, C. B., F. R. S., who for many years was a leader in public-health work in England, has stated the principle involved in the compulsory vaccination of children to be the counting of vaccination "among those conditions necessary for the maintenance of life which a parent should not be entitled to withhold (any more than food or clothing) from his offspring."[1] He said, however, that if, before the passage of the law for compulsory vaccination in England, he had had occasion to express an opinion on the subject, he would have feared the operation of such a measure. "Believing that vaccination is beyond all comparison the greatest practical good with which medical science has enriched us, I should have felt the utmost apprehension lest by association with penal provisions it might perhaps become unpopular; lest this apparently unnatural combination should excite resistance or suspicion; lest the public should in any degree mistrust a gift which the law would compel them to accept."[2] Soon after the passage of the law he attributed its apparent success partly to the "English habit of respecting every actual law."[3] The habit of a people of a country, their mode of thought, should undoubtedly be considered in coming to a conclusion as to whether general compulsory vaccination is the best measure to secure general vaccination.

Compulsory vaccination or revaccination of adults cannot be urged on the same principle as can the primary vaccination of children. There the question relates not to a child without discretion, but to the person of a responsible individual. "It relates chiefly to the protection of his own person, because if the public have such faith in vaccination or revaccination as to require it of him, the public itself can act on that faith, and each of its members can voluntarily be vaccinated and revaccinated, and thus be protected even if the individual who objects to vaccination shall contract the smallpox. The risk is chiefly, if not entirely, to the person himself, and not to the public (if vaccination and revaccination are as effective as we believe); therefore it is a question if every responsible individual should not be allowed to act upon his own best judgment as to what virus, if any, he will have inserted in his own person.

"Compulsory vaccination of an intelligent adult person is such an interference with the liberty of the individual relative to his own

[1] *Public-Health Reports*, John Simon, edited by Edward Seaton, vol. i. p. 281, London, Eng., 1887.

[2] *Ibid.*, vol. i. p. 282.

[3] *Ibid.*, vol. i. p. 283.

person as, in my judgment, is not for the public good. I think the final result will be better if the natural risk of the death-penalty by smallpox be permitted to each responsible person."[1]

However, it sometimes occurs that the "greatest good to the greatest number" seems to require that all persons who have been very recently exposed to smallpox shall either be vaccinated or revaccinated, as the case may be, or that they shall be completely isolated from the public until such time as danger of their having or spreading the disease is passed. In such cases it would seem best to advise vaccination and to require one or the other alternative. The health officer of one great city in the United States[2] has, however, under such circumstances, permitted persons so exposed to go about under limited surveillance, they reporting to his office at stated times. This action was based upon the belief that smallpox is not communicated by the patient during the early stages of the disease.

As an illustration of an alternative measure to compulsory vaccination the experience in New York City is instructive: "In the spring and fall vaccinators are employed for temporary service, in addition to the regular vaccinating corps. The city is then divided into a number of districts. A vaccinator is placed in each, who visits every house and vaccinates all infants over three months of age whose parents desire it. In this way about thirty thousand children are vaccinated annually. Adults who request it are also vaccinated. The operation is performed upon from eighty to ninety thousand persons every year."[3]

As to the results of this method Dr. Edson says: "The vaccinating corps of the health department was organized in 1874. The result of its work was not apparent until until 1876. The deaths from smallpox previous to 1876 averaged 59.57 per 100,000 per year; since 1876 they have averaged 8.38 per 100,000 per year, and this average is yearly being reduced. During the past sixteen months we have had only two cases of the disease in New York City. One of these cases occurred in the most thickly-populated part of the city, where the number of inhabitants per acre is greater than on any other spot in the world, yet so well was the neighborhood protected that not a single case occurred among the many persons that were exposed."[4]

The foregoing fact illustrates how smallpox may be prevented in a city. How a State can act for the prevention of smallpox is illustrated by the experience in Michigan, where previous to the establishment of a State board of health smallpox was an important cause of mortality. Soon after its establishment the State Board of Health published and

[1] *Trans. Mich. Med. Soc.*, 1890.

[2] Dr. O. W. Wight, then health officer of Detroit, Michigan.

[3] Dr. Edson, in the *Forum*, June, 1890, p. 480.

[4] *Forum*, June, 1890, p. 480.

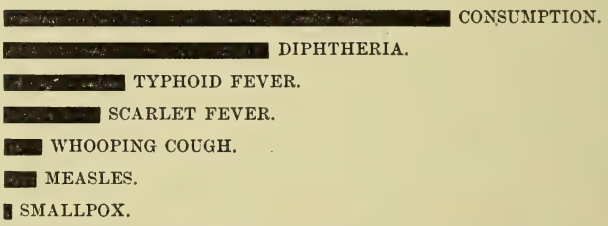
distributed widely throughout the State a pamphlet containing brief but plain directions how to restrict and how to prevent smallpox through vaccination and revaccination. Attention was called to a State law which authorizes the board of health of each city, village, and township at any time to direct its health physician to offer vacccination, with bovine virus, to every child not previously vaccinated, and to all other persons who have not been vaccinated within the preceding five years, without cost to the person vaccinated, but at the expense of the city, village, or township as the case may be.

From time to time the State Board of Health in Michigan called the attention of the numerous local health officers, and called public attention, to the importance of vaccination; and such efforts were at times very successful, because of the fact of the occurrence of cases of smallpox. Printed leaflets setting forth reasons why "this is a good time to be vaccinated" have done much to call attention of the people to the subject.

How effective have been such measures as are employed for the prevention of smallpox may be appreciated by a study of a diagram exhibiting the present place of smallpox among diseases in Michigan, and remembering that before the time of vaccination, previous to this century, smallpox was one of the diseases which caused most deaths.

FIG. 142.

Deaths in Michigan, 1876–87.



This diagram is accurately drawn to a scale, and the *relative importance* of each disease, as a cause of deaths in Michigan, is therefore correctly shown.

The Michigan State Board of Health was established in 1873. A comparison of the deaths from smallpox reported to the Secretary of State as having occurred in Michigan during the five years (1869–73) preceding the organization of the State Board of Health, with the fourteen years (1874–87) since the State Board of Health was established, and making corrections for increase of population, proves that the death-rate from smallpox in Michigan has been reduced 6.62 persons per year per 100,000 inhabitants, and that 1554 persons who, according to the death-rate previous to the establishment of the State Board of Health, would have died of smallpox, have not died—their lives have been saved. One thousand five hundred lives saved from smallpox

means a saving also of at least six thousand cases of sickness from that loathsome disease.

Typhoid Fever, as Influenced by Water-supply and Sewerage.—The recorded instances of the prevention of typhoid fever through improved sanitary conditions, notably improved water-supplies and improved systems of disposal of human excreta, supply an important basis for practical sanitation, because it seems fair to assume that what man has done man may do in this direction.

One of the most complete and reliable summaries of the evidence on this subject that has ever been published is in an article entitled "The Influence of Sewerage and Water-supply on the Death-rate in Cities," by Irwin F. Smith (now of the U. S. Department of Agriculture), published by the Michigan State board of health in the Proceedings of the Sanitary Convention held at Ypsilanti in 1885. From that and other sources a few of the most striking instances are here mentioned.

The city of Munich, Bavaria, is the home of the eminent scientist and sanitarian, Professor Max von Pettenkofer. For many years he has devoted much time and labor to the subject of the causation and prevention of typhoid fever. It is therefore probably more than a coincidence that in that city there has been the most remarkable evidence of the lessening of typhoid fever that has ever been recorded. Previous to 1859 there were no sewers or regulations for keeping the soil of the city clean; the water-supply was from wells; the citizens avoided the well-water when possible, and strangers were warned not to use it; the mortality from typhoid fever was 24.20 per 10,000 inhabitants. In 1860 to 1865 reforms were begun by cementing the sides and bottoms of porous vaults and cess-pits; the mortality from typhoid was then 16.80. During the years 1866 to 1873 there was partial sewerage; the mortality from typhoid fever was 13.30. During 1874 to 1880 sewerage was continued; the mortality from typhoid fell to 9.26. During 1881 to 1884 sewerage was still further continued, and the mortality from typhoid fell to 1.75 per 10,000 inhabitants.[1] Since that time it has been claimed that typhoid fever has practically disappeared from Munich—that there are no cases of the disease contracted in the city, the only cases seen being those that come there after having contracted the disease outside that city.

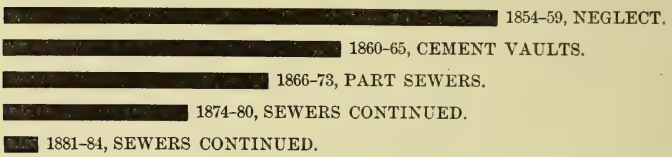
This would seem to prove that it is possible to prevent typhoid fever entirely. It seems to prove what are the essential measures for the accomplishment of that very desirable result. However, it is important to hold in mind at least one fact which in the foregoing brief summary has not received proper notice: that fact is that coincidently

[1] The lessening of typhoid in Munich is graphically exhibited in the diagram (Fig. 143) on page 564.

with the improvements in the methods of disposal of excreta, which are mentioned as having occurred in Munich, there were improvements in the water-supply other than those which are implied as having occurred through the securing of a cleaner soil underneath the city, because there was a progressive change from a water-supply derived from numerous local wells to general water-supplies from springs and other sources without the city.

FIG. 143.

Typhoid Fever and Sewers in Munich.



One who believes, with Pettenkofer, that the purifying of the soil is the principal element in the lessening of typhoid fever, may be inclined to disregard the fact of the coincident improvement of the water-supply in Munich as a factor in lessening the fever in that city; and, on the other hand, one who believes that typhoid fever is usually spread by means of the water-supply may be inclined to disregard the evidence relative to the disposal of excreta, except as that influenced the condition of the water-supply; yet in the present state of our knowledge of the subject it seems best in this instance to hold fast to the combined evidence as it stands, because, although to the writer it seems probable that the way in which typhoid fever is most commonly spread is through contaminated water used for drinking and other purposes, yet the possibility of its being spread in other ways, including that by dust from human excreta, remains for further investigation.

The mortality statistics in New Orleans, in connection with the facts relative to the lack of sewerage and the source of the water-supply in that city, seem to bear upon the question whether water-supply or sewerage has most influence on the death-rate from typhoid fever. In New Orleans there has been a general lack of sewerage; the water has been in great part rain-water derived from the roofs of buildings, where it would not be liable to as much contamination by excreta as would be water in wells: the death-rate from typhoid fever has been comparatively low, about as low as in New York, in which city there is both sewerage and a general water-supply.

Tabulated Records of Experience.—Probably the most important and most reliable basis for practical sanitation is that supplied by records of actual experiences in sanitation, collated, classified, tabulated, and so arranged as to give positive answers to definite questions con-

cerning results of certain measures. Some of the most valuable of such experiences have resulted from a belief in the germ theory of disease, and that theory has, in turn, received strong support from the experience.

Theories relative to disinfection also, based upon laboratory experiments, have contributed toward practices in sanitation: these experiences in turn have yielded positive knowledge of disinfection, as it has been thus applied, which is of great practical importance. Thus it has now been demonstrated, by the tabulated experiences in Michigan during a series of years, that isolation and disinfection are effective measures for the restriction of diphtheria and of scarlet fever. This seems to prove two things: (1) that these diseases are communicable; and (2) that the method of disinfection adopted is effective. As examples of the evidence on this subject two diagrams are here submitted, one exhibiting the results of experience with diphtheria (Fig. 144), and one with scarlet fever (Fig. 145). Each diagram relates to a single year, and

FIG. 144.

ISOLATION AND DISINFECTION RESTRICT DIPHTHERIA.

Diphtheria in Michigan in 1888.—Exhibiting the average number of cases and deaths *per outbreak:* in those outbreaks in which Isolation and Disinfection were both *Neglected*, and in those outbreaks in which both were *Enforced.* (Compiled in the office of the Secretary of the State Board of Health from reports made by local health officers.)

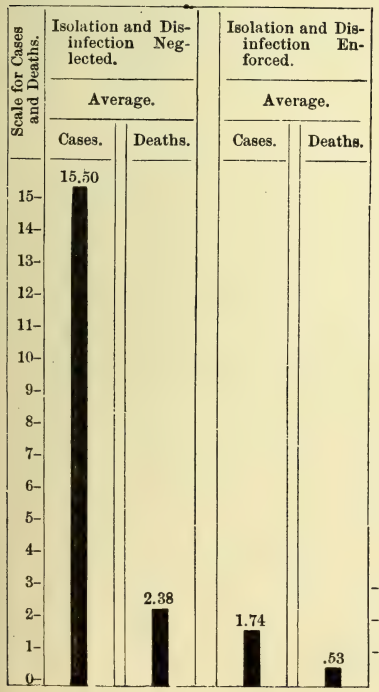
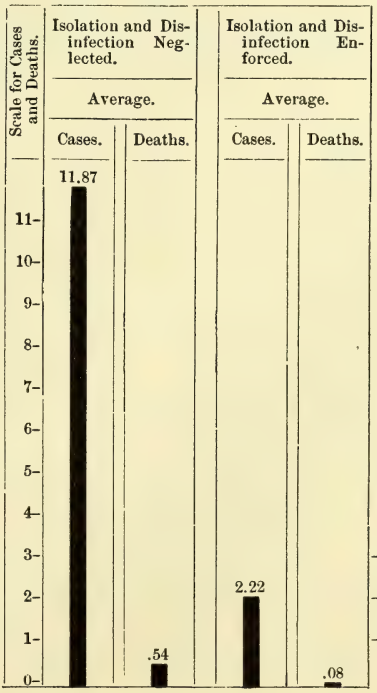


FIG. 145.

ISOLATION AND DISINFECTION RESTRICT SCARLET FEVER.

Scarlet Fever in Michigan in 1888.—Exhibiting the average number of cases and deaths *per outbreak:* in those outbreaks in which Isolation and Disinfection were both *Neglected*, and in those outbreaks in which both were *Enforced.* (Compiled in the office of the Secretary of the State Board of Health from reports made by local health officers.)



the experience proves that in those outbreaks in which isolation and disinfection were neglected there were several times as many cases and deaths as there were in those outbreaks in which isolation and disinfection were enforced.

The facts have been collected and compiled in Michigan for other years, and the general fact seems to be established that in townships and small cities and villages about four-fifths of the cases and deaths from scarlet fever, and about the same proportion of the cases and deaths from diphtheria, are prevented in those localities in which the first case or cases that occur are promptly isolated, and after death or recovery thorough disinfection is enforced. This statement relates only to those localities in which at least one case has already occurred; of course the danger of the disease spreading to other localities, and thus starting new outbreaks, is greatly lessened in those localities where prompt restrictive measures are enforced; therefore it is below the truth to say that in townships and small cities and villages four-fifths of the cases and deaths from scarlet fever and diphtheria are known to be prevented by isolation and disinfection.

This is a very important fact concerning both of these diseases, and is especially important relative to diphtheria, because in many parts of the country the people and the medical profession have been loath to believe that diphtheria was a communicable disease, and that it could be to such an extent prevented. It is important information on which to act, because in many parts of this country diphtheria is one of the diseases which causes most deaths, and scarlet fever also is a very important cause of death in the northern portions of this country.

A Few of the Functions of State Boards of Health.

Such information as that exhibited in the two diagrams, "Isolation and Disinfection restrict Diphtheria," and "Isolation and Disinfection restrict Scarlet Fever," could only be obtained in one way—namely, by collecting and compiling the facts concerning the experiences with those diseases under the different managements of local health authorities. This illustrates one of the most important functions of State boards of health—the collection, digestion, tabulation, and graphic representation of the experiences in different localities, and especially under differing conditions, with the view of learning what conditions it is important to maintain.

Another important function of State boards of health is the dissemination of such information to the people, to the medical profession, and especially to the local health authorities. To this last class of persons it is important especially, because of the fact that such local officers are subject to change, and a considerable proportion of them do

change each year, with the result that many of the local officers are entirely new to their official duties. By means of circulars of information, a State board of health can place before all local health officers such useful general facts as result from the collection and elaboration of the reported experiences under the jurisdiction of the several local officers. The State board can do more than that, because through its system of exchanges it receives the results of work on similar though not identical subjects which is done throughout the United States and throughout the world.

Thus through the proper services of a State board of health it is possible for each local health officer who is in close sympathy and correspondence with it to bring to bear upon any question of local sanitation the best knowledge on the subject in his own country or abroad.

Conversely, through reports to the State board of health it is possible for every local health officer to contribute valuable data which will be useful not only to his fellow health officers and citizens in his own State, but also to humanity throughout the civilized world.

At the last meeting of the Sanitary Institute of Great Britain[1] the Hon. F. A. R. Russell, with reference to the utility of a State board of health, said: "The fact is, infectious disease is not merely local, and cannot be dealt with effectually by local authorities, because if one is active another is negligent, and because such separate and uninformed authorities cannot attack the enemy with anything like the force or precision of a trained brigade. There is no escape from the urgent need of State control in respect of epidemic and spreading diseases, for a single neglected district is a danger to the whole nation."

National Health Service.

As the State board of health collects from each local board the results of its experience, and disseminates to every local board in its State the knowledge gained from the combined experiences, so the national board or other national health service should glean from the work of State, municipal, and other local boards of health whatever promises to be useful, and should combine with such facts mortality and morbidity statistics, meteorological, climatological, and other data, and results of laboratory investigations, with the view to the building up of sanitary science upon foundations of truth. Each State board of health should receive from the national board of health the results of the useful experiences of all State boards, and such information as the national board is able to obtain from foreign governments or from its own consuls, ministers, or agents in foreign countries. Economy in labor requires that the National Government shall do for the several States what otherwise each State must do for itself, and thus save

[1] At Brighton in 1890.

repeating many times the labor which should be done only once, but most thoroughly and completely, by one central office of the General Government.

There has been much quibbling and hair-splitting discussion as to whether the United States Congress has power to provide a national health service. But manifestly such a service is essential to the public welfare, and by the Constitution "Congress shall have power . . . . to provide for the common defence and general welfare of the United States." In fact, one of the purposes of the Constitution, as declared in the preamble, is to "promote the general welfare" of the "people of the United States," "ourselves and our posterity." Congress has established a national Department of Agriculture in order to "promote the general welfare" by fostering one of the most important industries in this country. This especially fosters the interests of a class of citizens, because of the exceeding importance of the labors of that class to the whole people of the United States. A national health service, however, would conserve the highest interests of every citizen, the interests of life itself, and would be far above any other interests of any class of citizens. Surely there should be no question as to the power and duty of Congress to provide a national health service.

As to what should be the nature of the national health service, some of the reasons previously mentioned for the existence of a State board of health apply with equal force for the existence of a national board of health. However, even greater stability and permanence could be provided for in other ways. Recent expressions of opinion are here mentioned.

At the International Medical Congress in Berlin in 1890, Dr. A. L. Gihon, Medical Director of the United States Navy, offered a resolution as follows: "*Resolved.* That it is the opinion of the Tenth International Medical Congress that there should be in every country an executive department of health, under the direction of a Cabinet minister, charged with the sanitary interests of the nation, the collection of its vital statistics, and the observations of the demographic effects of climate, occupation, and social conditions." [1]

At the meeting of the American Medical Association, in Washington, May 5, 1891, a resolution, reported by a committee, was adopted, as follows: "*Resolved,* That the president of this association appoint a committee of five to memorialize Congress at its next session on the subject of creating a Cabinet officer to be known as the Medical Secretary of Public Health." [2]

Among the reasons for the establishment of a national health service the committee of the American Medical Association close as

[1] *Report of the Surgeon-General U. S. Navy,* 1890, p. 28.
[2] *Journ. Amer. Med. Assoc.,* May 16, 1891, p. 719.

follows: "Finally, the unification of all things relating to public hygiene in the States through the aid of State boards of public health will give a solidity and usefulness to the practice of medicine never hitherto attained." [1]

In the "Address on State Medicine" at the last meeting of the American Medical Association, Dr. W. L. Schenck, professor of State Medicine and of Pathology in the Kansas Medical College, expressed himself on this subject as follows: "The enlightened statesman knows that the strength of a nation lies in the strength of its people, and that the highest function of law is the protection of their life, health, and development—that 'public health is public wealth.' When he comprehends that the great epidemics that destroy mankind, causing untold suffering and immeasurable financial loss, are amenable to State medicine, may we not believe that the National Government will establish *a department of public health*, under whose protecting ægis it will gather the Marine Hospital service, the Bureau of Education, of Vital Statistics, and of Animal Diseases, the Climatological and Signal Service, all that pertains to the health and development of the people; providing that, as in the army and navy, its appointments shall be preceded by thorough examination and be made for life? In such a department there would be enrolled a body of scientists unequalled in the world, working in harmony for the highest interests of mankind—the prevention of disease, the preservation of life, and the uplifting of humanity, giving dignity to State medicine, and the highest possible physical, intellectual, and moral development to the nation." [2]

Outline of the Leading Principles Applicable for the Prevention of the most Important Diseases.

It should be distinctly understood that the prevention of a disease generally requires the fulfilment of more than one measure. Usually there are several factors contributing to the causation of a disease, and many things can be done by individuals, by communities, and by governments to lessen the probabilities of persons contracting a dangerous communicable disease. However, there is usually some one dominant fact which it is pre-eminently important to consider in the prevention of disease.

Thus, for the restriction and prevention of consumption and other tubercular diseases probably the most important of all measures is the destruction or disinfection of all sputa of consumptive persons.

For the restriction and prevention of pneumonia it is probable that a similar measure is important.

For the restriction and prevention of typhoid fever the most important measures are those which tend to prevent the taking into the bodies

[1] *Journ. Amer. Med. Assoc.*, May 16, 1891, p. 719. [2] *Ibid.*, May 23, 1891, p. 733.

of persons, especially with the drinking-water, substances derived from or contaminated by human excreta. Much can be done by individuals, but more by governments, through provisions for sewerage and for public water-supplies of known purity.

For the restriction and prevention of diphtheria the prompt and continued isolation of all infected persons and things, and their thorough disinfection before they are released from isolation, are the important measures. For the restriction and prevention of scarlet fever the same measures are applicable.

For the prevention of intermittent fever the most important measure has been the lowering of the subsoil water. In some of the States public lands have been given by the government for the purposes of drainage of swamp-lands, and through such general measures of drainage malarial diseases have been very greatly lessened. This has been the case in Michigan.

Some of the most important diseases have now been mentioned, but the exceeding importance of the one which causes most mortality warrants its treatment a little more in detail.

The Restriction and Prevention of the Tubercular Diseases.—For this the most important measures are—

(*a*) *The Destruction or Disinfection of all Sputa of all Consumptive Persons.*—If this could be completely accomplished, it would probably go far toward the entire prevention of the disease known as consumption, and also the other tubercular diseases. But as this can hardly be expected during the lifetime of the present generation, other measures, tending to lessen the danger of contracting the disease are important.

The destruction of the sputa, however, is so important that extraordinary effort should be made to spread among all classes of people such knowledge of the causation of tubercular diseases as will tend to make the people willing to conform to measures for the destruction of all infected sputa. The fact should be impressed upon all that animals not infrequently contract tubercular disease from the sputa of man—that a phthisical herdsman might thus scatter tubercular disease through a herd of cows, the milk and meat of which might spread the specific cause of tubercular disease throughout a town. Inventive talent might well be employed in devising convenient, practicable methods of destroying all sputa. Portable spit-cups of paper, held in a metallic frame, the cup and contents to be removed and burned, have been devised and sold. A pocket-flask (Dettweiler's), to contain a disinfectant and to receive the sputa, is also on sale. I have recommended that a paraffined or otherwise prepared paper be sold, in pieces of convenient size and in packages somewhat as cigarette papers are sold, and that each sputum be received on such a paper, the ends carefully twisted, the whole then enclosed in another piece of the paper, and the ends

of that twisted, the package to be burned on the first convenient opportunity.

(*b*) *Measures for Lessening the Liability of Inhaling the Dust of Rooms occupied, permanently or temporarily, by a Consumptive Person, especially Public-Assembly Rooms, the Air in which is Liable to Contain the Dust from Dried Sputa of Consumptive Persons.*—One of these measures is the providing, in convenient places, of cuspidors containing a strong disinfectant. One of the most important measures, however, relates to the ventilation of all occupied rooms, which should be so planned that the movement of the air in the room should be constantly downward and out at the floor-level. This reduces to a minimum the danger of the particulate cause of consumption rising from the floor or carpet on which it may have fallen with the sputa of a consumptive person. Such a constant downward movement of the air of the room implies a constant renewal of the air in the room by the entrance of fresh air from out of doors. It also implies that either as it enters it is warmer than the air of the room, and will therefore immediately rise to the upper part of the room, or that the fresh air is caused to enter the room near the ceiling. Such a system of ventilation as will secure a constant moderate movement of air downward and out at the floor-level will be a useful sanitary measure, aside from its importance and usefulness in lessening the danger of inhaling contagia of disease with the dust of the room.

It is apparent that no individual can control, except to a limited extent, the ventilation of rooms into which he goes. All such measures for the common safety of life and health are proper subjects for action by individuals, by communities, and by governments, local, State, and national.

(*c*) So long as bovine animals used as human food have this disease to such an extent that in some localities as high as 4 per cent. are affected, it is desirable that measures be taken to lessen its spread through the use of tubercular meat or milk. There should be meat inspection, and also inspection by expert veterinarians to detect the disease in animals giving milk or to be slaughtered for food. Milk not known to be free from the bacillus may be boiled. To prevent the disease from being spread to dairy cows and to other food animals, those persons who care for such animals should be free from consumption, or, if not, should employ extraordinary care to avoid contaminating the food, water, or air-supply of such animals with the infected sputa.

(*d*) The researches of Bowditch, Buchanan, Pepper, Trudeau, and others have proved that residence in low, cold, undrained, cellar-like places favors the occurrence of consumption. My own researches have proved that sickness and deaths from consumption increase after exist-

ence in a cold atmosphere, and decrease after existence in a warm atmosphere; also, that consumption follows the occurrence of pneumonia and of the inflammatory diseases of the throat and air-passages, and that these follow existence in a cold atmosphere (Figs. 138, 139, and 140). The recent general movements of people whose greatest danger is in the lungs or air-passages to a warmer climate, at least during the colder months of the year, seem to be founded upon established facts, and many lives are thus prolonged.

(*e*) The tubercular diseases are wasting diseases, and there seem to be reasons for believing that an important factor in their prevention is the maintenance in perfection of the quality of the blood, especially of its albuminous constituents. Good food, and plenty of it, favors freedom from consumption.

(*f*) The importance of outdoor life for the prevention of consumption is generally accepted. How and why it is effective has not been much dwelt upon; but the increase of appetite for food consequent upon outdoor exposure is well known, as is also the fact that those oxidations of effete matters in the body which in persons who live indoors so frequently stop short of completion, and thus leave in the body irritating substances like uric acid, are more completely effected in persons who remain much in the outdoor air.

Theoretically, with our present knowledge consumption, which still is the most important cause of mortality, is now, next to smallpox, one of the most easily preventable diseases. The next quarter of a century should see it lessen in importance as a cause of deaths until it takes its place alongside of smallpox among diseases whose greatly lessened mortality has been brought about by special methods in general sanitation. Something of the importance of what this implies to mankind throughout the world may be inferred from a comparison of the present mortality-rates from consumption and smallpox. Such a comparison, for a representative State, is exhibited in Fig. 142.

DISINFECTION.

By GEORGE M. STERNBERG, M. D.

By "disinfection" we mean the destruction of the infecting power of infectious material. As in a considerable number of infectious diseases it has been demonstrated that infection depends upon the introduction of living micro-organisms into the body of a susceptible individual, it is evident that in these diseases disinfection consists in the destruction of these living "germs" of disease, or, in other words, that disinfection is accomplished by the use of "germicides."

In other diseases, in which no demonstration of a living infectious agent has yet been made, it seems extremely probable that we have also to deal with a *contagium vivum;* and laboratory experiments made upon the infectious material of some of these diseases—hydrophobia, vaccine virus, virus of sheep-pox—give support to this inference; for the virulence of this material is destroyed by the agents which are most fatal to known pathogenic bacteria.

We must inquire, first, where the infectious material which we propose to destroy is found. In the eruptive fevers this material is given off from the general surface of the body, and perhaps with the breath; in parasitic skin-diseases, from that portion of the surface invaded. In these diseases, therefore, it attaches itself to clothing, bed-linen, and articles handled by the infected person or remaining in his vicinity. In pneumonia, tuberculosis, diphtheria, scarlet fever, and whooping cough expectorated matters from the lungs or throat are to be considered infectious material. In glanders discharges from the nares or from ulcers upon the surface of the body contain the specific germ. In cholera the infectious agent is found in the alvine discharges, and to some extent in vomited matters. In typhoid fever the bacillus is not only in the alvine discharges and ulcerated intestinal glands, but also in the mesenteric glands, the spleen, the liver, and the kidneys; occasionally it is present in the urine. In anthrax and relapsing fever the specific germ is in the blood; in hydrophobia, in the salivary secretions and in the brain and spinal cord; in gonorrhœa, in the urethral discharge; in erysipelas, in the invaded tissues.

The infectious agent in some of the diseases mentioned does not, so far as we know, multiply outside of the bodies of infected animals; in

others it may multiply abundantly, under favorable conditions as to pabulum and temperature, external to and independently of the bodies of living animals—*e. g.* the bacillus of typhoid fever, of diphtheria, of glanders, of anthrax, the spirillum of cholera, the streptococcus of erysipelas.

The object of disinfection is to destroy infectious material of all kinds, wherever it may be found, and thus to restrict the prevalence of infectious diseases.

It should be remembered in practice that *nothing short of complete destruction of the infectious agent in a given mass of material constitutes disinfection;* for so long as the specific germ retains its vitality in any portion of the material this must be considered infected.

On the other hand, *there can be no disinfection in the absence of infectious material.* I find in a recent number of a sanitary periodical, under the heading "Medical Excerpts," an item to which the name of a distinguished gynecologist is attached, in which the following statement is made with reference to "Platt's chlorides:" "As a disinfectant I have used it in my house for over a year with great satisfaction." Now, the agent referred to has been proved by exact experiments to possess comparatively little disinfecting (germicide) power, although it is an excellent deodorant. Are we to suppose that the distinguished gynecologist above quoted had in his house infectious material which required to be destroyed "for over a year" at the time he used this agent "with great satisfaction"? I think not, and infer that he has fallen into the popular error of using the term "disinfectant" as synonymous with "deodorant."

Tests of Disinfection.—The most satisfactory tests of disinfection are those which are made directly upon pure cultures of known pathogenic bacteria; and we have now very extensive experimental data relating to the germicide power of various physical and chemical agents, as tested in this way. In the case of infectious material like the virus of hydrophobia, vaccine virus, etc., in which the specific germ has not yet been demonstrated, the question of disinfection is tested by inoculating into susceptible animals virus which has been subjected to the action of the agent under investigation.

In the present article the writer proposes to give a brief account of the experimental data relating to the value of the most useful disinfecting agents, and of others which have been supposed to be of value; also, some practical directions as to the use of the most important of these agents under different circumstances.

But first we must call attention to the fact that the power of a given chemical agent to destroy disease-germs depends upon several conditions, as follows:

(*a*) *The Kind of Germ.*—While it is true that an agent which will

destroy one pathogenic micro-organism will kill others of the same class, there are considerable differences in the vital resisting power of various pathogenic bacteria. Some are more readily killed by acids, and others by alkalies. The bacillus of typhoid fever has an exceptional resisting power to carbolic acid, the bacillus of glanders to mineral acids, etc. Thus, Boer found that the anthrax bacillus is destroyed in two hours by sulphuric acid in the proportion of 1 : 1700; the cholera spirillum, in the proportion of 1 : 1800; the bacillus of diphtheria, by 1 : 1200; the typhoid bacillus, by 1 : 500; the bacillus of glanders, by 1 : 250.

(*b*) *The Presence or Absence of Spores.*—The reproductive elements known as spores have a far greater resisting power to heat and to chemical agents than have the growing cells—"vegetative forms"—which multiply by binary division. It is therefore an important matter to determine what pathogenic bacteria form spores and what do not. The following are known to form spores: the anthrax bacillus, the tubercle bacillus, the bacillus of tetanus, the bacillus of malignant œdema, and the bacillus of symptomatic anthrax. The following, so far as is known, do not form spores: the pus cocci (*Staphylococcus pyogenes albus, citreus*, and *aureus*, and the *Streptococcus pyogenes*), the diplococcus of pneumonia (*Micrococcus Pasteuri*), the bacillus of typhoid fever, the bacillus of glanders, the bacillus of diphtheria, the spirillum of cholera, the spirillum of relapsing fever.

(*c*) *The Nature and Quantity of Associated Material.*—With some agents this is of special importance. Thus, the oxidizing disinfectants, like permanganate of potassium, are destroyed by contact with organic matter, and their power to oxidize and destroy germs is a quantitative reaction, being limited to a given amount of organic material, living or non-living. If, therefore, the living germs are associated with an excess of organic material, the oxidizing agent will be neutralized before they are destroyed. In the case of certain metallic salts also the presence of chemical compounds by which they are decomposed, or of organic material by which they are precipitated, must interfere with their germicidal action. Thus, Van Ermengen found that the cholera spirillum in bouillon is destroyed by mercuric chloride in the proportion of 1 : 60,000, while in blood-serum 1 : 800 is required to destroy the same micro-organism. The proportion of a chemical agent, then, which will destroy a pathogenic bacterium suspended in distilled water or bouillon may differ very materially from the proportion of the same agent which will be required for the disinfection of excreta and other material containing considerable organic matter.

(*d*) *The Number of Bacteria* is also an essential factor which must have due consideration. It has been demonstrated by experiment that a few bacteria suspended in bouillon, for example, are destroyed by a smaller amount of the various disinfecting agents than the numerous

progeny of these few would require if the culture were placed in an incubating oven for twenty-four hours.

(*e*) *The Time of Exposure* is also an important factor. Some agents, such as the hypochlorite of lime, permanganate of potassium, and active oxidizing disinfectants in general, act very promptly, while others require a contact of considerable duration to ensure the destruction of pathogenic bacteria.

(*f*) *The Temperature* at which the exposure to the disinfecting agent is made has a material influence upon the result. This is shown by the experiments of Henle, Hünermann, and others.

(*g*) *The Degree of Dilution* of the disinfecting agent is also a matter of importance. This is especially true of the mineral acids. If we suspend a silk thread to which anthrax spores are attached in a solution of sulphuric acid or of caustic potash, the strength of the solution is a more important factor than the quantity. It probably makes but little difference whether our threads are suspended in a fluidounce or a gallon of a 2 per cent. solution, for example. But in the case of an active oxidizing agent, like potassium permanganate, the quantity of the salt present in the solution is the essential point, for disinfection depends upon a chemical reaction in which a given amount of organic material is oxidized by a definite quantity of the oxidizing agent. The fact that the required amount is dissolved in a greater or less quantity of water is, within certain limits, of minor importance. When, therefore, we are informed that a certain pathogenic micro-organism is destroyed in half an hour by permanganate-of-potassium solution of the strength of 1 : 500, we require to know also how much of a solution of this strength is necessary to destroy a given quantity of a culture in bouillon or some other standard culture-medium in order to judge of the practical value of the agent in question.

From what has been said, it is evident that in comparing the results of different experimenters we must be informed as to the details of the method employed by each, and that corresponding results can only be expected when the conditions have been identical. As a matter of fact, very different methods have been employed by different experimenters. Thus, Koch and some of his pupils have suspended silk threads to which the test-organism is attached in a standard solution of the disinfecting agent, and have ascertained the time required to accomplish disinfection; others have suspended in a given quantity of distilled water or of bouillon the test-organisms taken from a pure culture by a small platinum loop—*öse*; others have operated upon pure cultures in bouillon or other media which have been placed in the incubating oven for twenty-four hours or more. The writer has used such cultures in his experiments, and has adopted two hours as the standard time of exposure.

We cannot attempt in the present article to give a complete account of the experimental data relating to disinfectants, but will pass in review those agents which have been shown to have decided germicide power, and to be most useful from a practical point of view.

Physical Agents.

Heat is undoubtedly entitled to the first place among the agents available for the destruction of infectious material external to the bodies of living animals. Extended experiments have been made to determine the thermal death-point of known pathogenic bacteria. These experiments show that those species which do not form spores are killed at a comparatively low temperature, and that the spores of the anthrax bacillus and of the tubercle bacillus are quickly destroyed by the temperature of boiling water. In the following table we give the results of experiments made by the writer and by others upon the most important pathogenic bacteria, and upon certain kinds of virulent material in which the specific germ has not been demonstrated:

Thermal Death-Point of Pathogenic Bacteria.

	Determined by	Centi-grade.	Fahren-heit.	Time of Exposure, Minutes.
Cholera spirillum	Sternberg	52°	125.6°	4
Typhoid bacillus	Sternberg	56°	138.8°	10
Anthrax bacillus	Chauveau	54°	129.2°	10
Glanders bacillus	Löffler	55°	131°	10
Diphtheria bacillus	Löffler	60°	140°	10
Streptococcus of erysipelas	Sternberg	54°	129.2°	10
Staphylococcus pyogenes aureus	Sternberg	58°	136.4°	10
Diplococcus of pneumonia [1]	Sternberg	52°	125.6°	10
Gonococcus [2]	Sternberg	60°	140°	10
Bacillus of rouget [3]	Sternberg	58°	136.4°	10
Bacillus of fowl cholera	Salmon	56°	132.5°	10
Anthrax spores	Sternberg	100°	212°	4
Bacillus tuberculosis	Schill & Fischer	100°	212°	4
Vaccine virus	Carstens & Coert	54°	129.2°	10
Rinderpest virus	Semmer & Raupach	55°	131°	10
Sheep-pox virus	Semmer & Raupach	55°	131°	10
Hydrophobia virus	Sternberg	60°	140°	10

By reference to the table it will be seen that a temperature of 60° C. (140° F.) is fatal to all of the pathogenic bacteria in the list with the exception of the tubercle bacillus and anthrax spores, and also that the virus of several infectious diseases in which the specific infectious agent has not been demonstrated is destroyed by the same temperature. It seems probable that the virus of smallpox would be destroyed by the

[1] *M. Pasteuri* (Sternberg).

[2] A single experiment, by inoculation in the healthy urethræ of two individuals, of gonorrhœal pus exposed to a temperature of 60° C. for ten minutes.

[3] *Schweine rothlauf* of the Germans.

temperature which neutralizes the potency of vaccine virus. We have, therefore, experimental data applicable for the use of heat as a disinfecting agent in nearly all of the important infectious diseases of man and the lower animals; and it is extremely probable that in those diseases in which we are still without satisfactory experimental data—yellow fever, scarlet fever, measles, whooping cough—we will be safe in assuming that the temperature which kills the tubercle bacillus and anthrax spores (212° F.) will be sufficient to accomplish disinfection. Allowing an ample margin of time on the side of safety, we may direct the disinfection of all kinds of infectious material by subjecting it to a boiling temperature for half an hour. This may be effected by immersion in boiling water or by exposure to steam which has the same temperature. The use of an apparatus in which infected articles are exposed to steam under pressure will enable us to shorten the time of exposure. With a temperature of 105° C. (221° F.) ten minutes' exposure would be ample time.

The fact that the spores of certain bacilli found in the soil resist a considerably higher temperature than this has led to undue exactions in the use of heat. In our judgment, the spores of the anthrax bacillus furnish as difficult a test of disinfecting power, either by heat or by chemical agents, as should be required in the present state of knowledge; and, as we have seen, these are destroyed by four minutes' exposure to the boiling temperature.

Dry heat is far less effective, and the experimental data given relate to the use of moist heat. Koch and Wolfhügel found, as a result of extended experiments, that the spores of bacilli require for their destruction in dry air a temperature of 140° C. (284° F.) maintained for three hours.

The experiments of Esmarch show that superheated steam is less effective than streaming steam at 100° C. It has about the same value as dry air at a corresponding temperature. This is an important practical point which should be kept in view in constructing steam disinfecting apparatus.

It is evident from what has been said that the simplest way of disinfecting articles of clothing and other objects which are not injured by the operation is to immerse them in boiling water. As the cholera spirillum is killed at 52° C., and the typhoid bacillus at 56° C., we may disinfect the excreta of patients with cholera and typhoid fever by pouring a considerable quantity of boiling water—three or four times the amount of the material to be disinfected—into the vessel containing them; and by dissolving in boiling water a good deodorant, such as the sulphate of iron or chloride of zinc, we will disinfect and deodorize at the same time—an important point in domestic practice. In hospitals a suitable receptacle might be provided for each ward,

from which a boiling solution of one of the salts mentioned could be conveniently obtained for the disinfection of the contents of bed-pans, etc.

Cold does not destroy bacteria. The typhoid bacillus still retains its vitality after being frozen for 103 days (Prudden). A temperature of —87° C. does not destroy the vitality of cocci and bacilli (Frisch). Portions of tuberculous lung kept in a frozen condition for four months still produced tuberculosis in guinea-pigs (Cadèac and Malet).

LIGHT.—Exposure to direct sunlight is fatal to many species of bacteria, and even diffused light has been shown to have some germicide power. Duclaux (1885) made experiments with pure cultures of micrococci, and found that species which retained their vitality for months in a dark place were killed in from three to forty days when exposed to direct sunlight. The spores of the anthrax bacillus are still more susceptible to the action of direct sunlight, being killed in eight or ten days (Arloing).

ELECTRICITY.—The recently-published experiments of Spilker and Gottstein show that an induction current of electricity has decided germicide power. In these experiments the conducting wire was passed in a spiral coil around a tube of glass or clay containing a culture of bacteria to be tested. In tubes having a diameter of 3.5 cm. a current of from ten to twelve ampères killed various test-organisms in an hour or more. When the time was reduced, sterilization was not complete, but development in culture media was retarded.

DESICCATION.—Some pathogenic bacteria are killed very promptly by desiccation. Thus, bouillon cultures of the cholera spirillum, dried upon a thin cover-glass, will not grow after three hours (Koch); cultures in gelatin or agar, which forms a thicker layer, are killed by desiccation at ordinary temperatures within two days (Kitisato). The tubercle bacillus and the bacillus of diphtheria, on the other hand, resist desiccation for several months. The typhoid bacillus dried on a cover-glass retains its vitality for eight or ten weeks (Pfuhl).

OXIDIZING DISINFECTANTS.

OXYGEN.—Pathogenic bacteria retain their vitality in culture media when freely exposed to atmospheric oxygen for periods varying from a few weeks to many months, and even when dried in a thin layer upon a cover-glass some of them are capable of development at the end of several months. We are not able to ascribe the dying out of these bacteria in old cultures to the influence of oxygen, inasmuch as this gas is essential to the growth of the aërobic species; and it has been shown that exposure to light and to the chemical products evolved by the bacteria themselves are factors which, in time, are sufficient to account for loss of vitality.

Paul Bert has shown that compressed air (twenty-three atmospheres) arrests putrefaction, and the experiments of Grossman and Mayerhauser show that under a pressure of from five to seven atmospheres pure oxygen gas kills bacteria in from six to twenty hours.

Nascent oxygen is a very potent disinfecting agent, as will be seen when we come to speak of potassium permanganate and calcium hypochlorite.

Ozone.—Numerous experiments have been made with ozone, the general result of which is to show that, practically, this agent has but little value. Lukaschewitsch found that 1.5 grammes in a space of a cubic metre failed to kill anthrax spores in twenty-four hours. In the same proportion the cholera spirillum, exposed in a moist condition, was not killed in fifteen hours, but, as a rule, no development occurred after twenty-four hours' exposure. In these experiments ozone was developed by electricity. Wyssokowicz found that the anthrax bacillus, the typhoid bacillus, and others tested were restrained in their development by the presence of ozone in culture media containing them, but believes this to be due to oxidation of bases contained in the nutrient medium rather than to a direct effect upon the pathogenic micro-organisms. The elaborate experiments of Sonntag also lead him to the conclusion that ozone has no practical value as a disinfectant.

Hydrogen Peroxide.—This is a valuable antiseptic and deodorant, but has no great practical value as a disinfectant. In the writer's experiments a solution was used containing 3.98 per cent. of H_2O_2 and 5 per cent. of sulphuric acid. Tested upon a culture of the anthrax bacillus containing spores, this solution was effective in the proportion of 20 per cent., and failed at 10 per cent. Tested upon a pure culture of a micrococcus, it was effective at 10 per cent., and failed at 5 per cent. (time of exposure two hours). But in these experiments we must take into account the sulphuric acid which was added to the solution to retard the loss of H_2O_2. Altehofer experimented with a solution containing 9.7 per cent. of H_2O_2, with the following results: To 2 cc. of a bouillon culture of the typhoid bacillus and 98 cc. of hydrant-water was added H_2O_2 in the proportion of 1 : 1000. The bacillus was killed at the end of twenty-four hours. A culture of the cholera spirillum treated in the same way was not entirely sterilized at the end of twenty-four hours.

Potassium Permanganate.—A 1 per cent. solution of this salt was found by Koch not to kill anthrax spores in two days, but 5 per cent. was effective in one day. Löffler found that a 1 per cent. solution was fatal to the bacillus of glanders in two minutes. In the experiments of Jaeger, 1 : 100 was not reliable for sterilizing anthrax cultures (without spores), but 1 : 20 was. The same proportion killed the bacillus of glanders and of fowl cholera, but failed to kill the tubercle bacillus.

Evidently, the amount of organic material associated with the bacteria to be destroyed is an important factor when this agent is used for disinfecting purposes. Thus, in the writer's experiments 2 per cent. failed in two hours to kill *M. Pasteuri* in the blood of a rabbit. This salt is therefore not reliable as a disinfectant, unless used in solutions of 5 per cent. or more, and its general use for disinfecting purposes is not to be recommended.

Chlorinated Lime owes its germicide value to the amount of hypochlorite of lime which it contains. Commercial chlorinated lime usually contains from 20 to 30 per cent. of available chlorine when it has been preserved in an air-tight receptacle, but it loses its chlorine when exposed to the air for some time. Experiments made under the writer's direction in 1885 demonstrated that "a solution containing 1 : 400 of chlorine as hypochlorite is an effective germicide when allowed to act for a very short time." Subsequent experiments have confirmed the value of this agent, and show that it is extremely prompt in its action. The experiments of Bolton, made under the writer's direction, gave the following results: The time of exposure being two hours, the typhoid bacillus and the cholera spirillum were killed by 1 : 1000 (containing 0.03 per cent. of available chlorine). Anthrax spores were killed in the same time by a solution containing 0.3 per cent. of available chlorine. Jaeger found that a 1 per cent. solution killed the anthrax bacillus and several other pathogenic micro-organisms tested, but that anthrax spores required a solution of 1 : 3 to ensure their destruction. The strength of his solution in available chlorine is not given. Nissen, whose experiments were made more recently (1890) in Koch's laboratory, found that anthrax spores were destroyed in thirty minutes by a 5 per cent. solution, and in seventy minutes by a 1 per cent. solution. In his experiments the typhoid bacillus and the cholera spirillum were destroyed with certainty in five minutes by a solution containing 0.12 per cent.; the anthrax bacillus, in one minute by 0.1 per cent.; *Staphylococcus pyogenes aureus*, in one minute by 0.2 per cent. Experiments made by the same author on the sterilization of fæces showed that 1 per cent. could be relied upon to destroy the bacillus of typhoid fever and the spirillum of cholera in fæces in ten minutes. These results fully confirm the practical value attached to this agent by the Committee on Disinfectants of the American Public Health Association, of which the writer was chairman, and justify the recommendation made in the final report of this committee (1887):

"*Dissolve chlorinated lime of the best quality*[1] *in pure water in the proportion of six ounces to the gallon.* Use one quart of this solution

[1] Good chlorinated lime should contain at least 25 per cent. of available chlorine. It may be purchased by the quantity for about three and a half cents per pound.

for the disinfection of each discharge in typhoid fever, cholera, etc. Mix well and leave in the vessel for at least one hour before throwing into privy-vault or water-closet. The same directions apply for the disinfection of vomited matters. Infected sputum should be discharged directly into a cup half full of the solution."

Chlorine.—The haloid elements are active germicide agents, and especially chlorine on account of its affinity for hydrogen and the consequent release of nascent oxygen when it comes in contact with micro-organisms in a moist condition. The germicide power of chlorine has been carefully tested by Fischer and Proskauer. These experimenters found that in the absence of moisture desiccated anthrax spores are not killed by exposure for an hour in an atmosphere containing 44.7 per cent. of this gas. When, however, the spores were moistened, exposure for an hour in a moist atmosphere containing 4 volumes per cent. of chlorine was effective, and when the time was extended to three hours 1 per cent. killed anthrax spores. The anthrax bacillus in the absence of spores was killed by exposure in a moist atmosphere containing 1 : 2500, the time of exposure being twenty-four hours; the streptococcus of erysipelas and the micrococcus of fowl cholera were killed in the same time by 1 : 25,000, and in three hours by 1 : 2500.

Notwithstanding its considerable germicide value, the practical use of chlorine for disinfecting purposes is limited on account of its corrosive properties. It may, however, be used, with proper precautions, for the disinfection of hospital wards, etc.

Iodine.—In the writer's experiments this agent was found to be fatal to pus micrococci in two hours in the proportion of 1 : 500 (dissolved by means of potassium iodide). "Iodine-water" destroys the vitality of anthrax spores in twenty-four hours (Koch).

Iodine Terchloride (IC_3).—According to Behring, we have in this agent a disinfectant which possesses the potency of free chlorine and of iodine, without having their disadvantages. As prepared by Riedel, it is a yellowish-red powder of penetrating odor. It remains unchanged for weeks in concentrated aqueous solution (5 per cent.). A 1 per cent. solution destroys anthrax spores suspended in water almost instantly, and a 0.2 per cent. solution within a few minutes. Anthrax spores in blood-serum were killed by a 1 per cent. solution in forty minutes (Behring).

Iodoform has no germicide power, but restrains the development of micro-organisms to some extent when added to nutrient media. It is probable that in contact with suppurating wounds and ulcers it undergoes a gradual decomposition, and that iodine is set free.

Iodol is also destitute of germicide power, probably because it is quite insoluble.

Acids.

Sulphuric Acid.—Koch found that anthrax spores still grew after exposure in a 1 per cent. solution of sulphuric acid for twenty days. In the writer's experiments a 4 per cent. solution failed to destroy the spores of *B. subtilis* in four hours, but 1 : 200 destroyed pus cocci in the same time. Boer, in more recent experiments, finds a considerable difference in the resisting power of various pathogenic bacteria. Bouillon cultures of twenty-four hours gave the following results, the time of exposure being two hours: Anthrax bacilli (without spores), 1 : 1300; diphtheria bacillus, 1 : 500; glanders bacillus, 1 : 200; typhoid bacillus, 1 : 500; cholera spirillum, 1 : 1300.

Hydrochloric Acid.—In Koch's experiments a 2 per cent. solution killed anthrax spores in ten days, but failed to do so in five days. In the writer's experiments a 10 per cent. solution failed to kill spores in two hours. Boer gives the following as the result of his experiments, the time of exposure being two hours: Anthrax bacillus, 1 : 1100; diphtheria bacillus, 1 : 700; glanders bacillus, 1 : 200; typhoid bacillus, 1 : 300; cholera spirillum, 1 : 1350.

Nitric Acid.—In the writer's experiments a solution of 8 per cent. killed spores in two hours, and 5 per cent. failed. Kitisato obtained results corresponding with those obtained by him with hydrochloric acid—viz. 0.2 per cent. destroyed the typhoid bacillus in five hours, and 0.132 per cent. destroyed the cholera spirillum in the same time.

These results show that we may safely use the mineral acids named for disinfecting material containing pathogenic bacteria in the absence of spores, and that the cholera spirillum especially has but little resisting power to these agents. Sulphuric and hydrochloric acid, therefore, both of which are comparatively cheap, may be used for the disinfection of excreta. We would recommend the use of a 4 per cent. solution for this purpose, adding it in equal amount to the material to be disinfected.

Sulphurous Acid.—In the writer's experiments micrococci were destroyed in two hours by 1 : 2000, by weight, of liquid SO_2 in solution in water. Kitisato found that sulphurous acid in the proportion of 0.28 per cent. killed the typhoid bacillus, and 0.148 per cent. the cholera spirillum.

Sulphur Dioxide, when anhydrous, has comparatively little disinfecting power, but in the presence of moisture sulphurous acid (H_2SO_3) is formed, and this is a potent germicide in the absence of spores. Koch exposed various species of bacilli containing spores in a disinfection-chamber for ninety-six hours, the amount of SO_2 at the outset of the experiments being 6.13 volumes per cent., and at the end

of the experiments 3.3 per cent. The result was entirely negative. The writer's experiments show that anthrax spores will germinate after pure SO_2 in a liquid form has been poured upon them. Micrococci exposed in a bell-jar for eighteen hours to 20 volumes per cent. did not grow, but when the amount was reduced to 4 volumes per cent. development sometimes occurred. When the micro-organisms are exposed in a moist condition, the results correspond with those obtained by the use of sulphurous acid. Thus, Koch found that the anthrax bacillus as obtained from the spleen of a mouse, exposed in a moist condition on silk threads, was killed in thirty minutes in an atmosphere containing 1 per cent. of SO_2. An aqueous solution containing 5.718 per cent. required five days to kill anthrax spores.

The data given, which might be greatly extended, will suffice to show that anhydrous sulphur dioxide has no practical value as a disinfecting agent, and that sulphurous acid is a useful agent in the absence of spores. We therefore recommend its use under proper conditions, as laid down by the Committee on Disinfectants of the American Public Health Association:

"For the destruction of infectious material which owes its infecting power to the presence of micro-organisms not containing spores the committee recommends— . . . .

"10. *Sulphur Dioxide.*—Exposure for twelve hours to an atmosphere containing at least 4 volumes per cent. of this gas[1] in presence of moisture."

But in connection with this recommendation we call attention to the following quotations from the report of the committee referred to:

"When an apartment occupied by a person sick with an infectious disease has been vacated, it should be disinfected. The object of disinfection of the sick-room is mainly the destruction of infectious material attached to surfaces or deposited as dust upon window-ledges, in crevices, etc. If the room has been properly cleansed and ventilated while still occupied by the sick person, and especially if it has been stripped of carpets and unnecessary furniture at the outset of his attack, the difficulties of disinfection will be greatly reduced.

"All surfaces should be thoroughly washed with the standard solution of chloride of lime diluted with 3 parts of water or with 1 : 1000 solution of corrosive sublimate. . . . .

"As an additional precaution fumigation with sulphurous acid gas is to be recommended, especially for rooms which have been occupied by patients with smallpox, scarlet fever, diphtheria, typhus fever, and yellow fever. But fumigation with sulphurous gas alone, as commonly practised, cannot be relied upon for the disinfection of the sick-room

[1] This will require the combustion of between three and four pounds of sulphur for every 1000 cubic feet of air-space.

and its contents, including bedding, furniture, infected clothing, etc., as is popularly believed."

Nitrous Acid.—In the writer's experiments the potency of vaccine virus was destroyed by exposure for six hours to an atmosphere containing 1 per cent. of nitrous acid gas.

Chromic Acid.—Koch found that a solution of 1 per cent. destroyed anthrax spores in from one to two days.

Phosphoric Acid.—A solution of 0.3 per cent. is fatal to the typhoid bacillus, and 0.132 per cent to the cholera spirillum (Kitisato).

Lactic Acid.—The bacillus of typhoid fever is killed by 0.4 per cent., the spirillum of cholera by 0.27 per cent.—time of exposure from four to five hours (Kitisato).

Acetic Acid.—The bacillus of typhoid fever is killed in five hours by 0.3 per cent., the spirillum of cholera by 0.2 per cent. (Kitisato).

Citric Acid.—The bacillus of typhoid fever is killed in five hours by 0.43 per cent., the spirillum of cholera by 0.3 per cent. (Kitisato).

Oxalic Acid.—The typhoid bacillus is killed in five hours by 0.36 per cent., the cholera spirillum by 0.28 per cent. (Kitisato).

Boric Acid.—The typhoid bacillus is killed by 2.7 per cent., the cholera spirillum by 1.5 per cent. (Kitisato). In the writer's experiments a saturated solution failed to kill pus micrococci in two hours. A 5 per cent. solution failed to destroy anthrax spores in two days.

Salicylic Acid.—In the writer's experiments this acid was dissolved by means of sodium borate, which by itself has no germicide power. A 2 per cent. solution was found to destroy pus cocci in two hours. Salicylic acid dissolved in oil or in alcohol in 5 per cent solution does not kill anthrax spores (Koch). According to Behring, salicylic acid is about twice as potent as carbolic acid, but it is very slightly soluble (1 : 400). Salicylate of sodium has very little value as a germicide.

Tannic Acid.—A 5 per cent. solution failed in ten days to destroy anthrax spores (Koch). Micrococci are destroyed by 1 : 400 (Abbott). In the writer's experiments a 1 per cent. solution destroyed *M. Pasteuri* in the blood of a rabbit in half an hour. The cholera spirillum is killed in four hours by 1.3 per cent., the typhoid bacillus by 1.6 per cent. (Kitisato).

Alkalies.

Calcium Oxide.—From a practical point of view the most important disinfecting agent among the caustic alkalies is recently-burned "quicklime." This destroys the bacillus of typhoid fever, of diphtheria, of glanders, and the cholera spirillum, after several hours' exposure, in the proportion of 50 cc. *normallauge* per litre (Behring).

Its germicide power is not interfered with by the presence of albuminous material, but is neutralized by phosphates, carbonates, and other bases.

Milk of lime for disinfecting purposes may be prepared by gradually adding 8 parts of water to 1 part, by weight, of powdered hydrate of lime. This should be freshly prepared or protected from the air to prevent the formation of the inactive carbonate of lime. According to Kitisato, the typhoid bacillus and the cholera spirillum in bouillon cultures are destroyed by the addition of 0.1 per cent. of calcium oxide. In the writer's experiments the typhoid bacillus was killed in two hours by pure calcium oxide suspended in water in the proportion of 1 : 40, but 1 : 80 failed. A mixture containing 1 : 5 failed to kill anthrax spores in two hours. In the use of this agent time is a very important factor, and long exposures are required to ensure disinfection. For this reason it is more useful in latrines and cesspools than for the disinfection of excreta in the sick-room. Pfuhl has experimented upon sterilized fæces to which pure cultures of the typhoid bacillus or cholera spirillum were added. The liquid discharges of patients with typhoid fever or diarrhœa were used for the purpose. He found that sterilization was effected by adding fragments of calcium hydrate in the proportion of 6 per cent. at the end of two hours, and that 3 per cent. was effective in six hours. When a milk of lime was used, which could be thoroughly mixed with the dejecta, the result was more favorable. The typhoid bacillus was killed in one hour by the addition of 2 per cent. of a standard preparation of milk of lime containing 20 per cent. of calcium hydrate. Similar results were obtained with liquid fæces to which a pure culture of the cholera spirillum had been added.

For the disinfection of latrines the addition of milk of lime in the proportion of 5 parts to 100 parts of the contents of the vault, and the daily addition of 10 parts for 100 parts of daily increment of fæces, is to be recommended.

The practical value of lime-wash applied to walls has been determined by Jaeger. Silk threads soaked in cultures of various pathogenic bacteria were attached to boards, and the milk of lime was applied with a brush. Anthrax bacilli (without spores), the bacillus of glanders, *Staphylococcus aureus*, and several other pathogenic bacteria were killed by a single application at the end of twenty-four hours. On the other hand, the tubercle bacillus was not killed by three successive applications of milk of lime (20 per cent.).

Potash.—In the writer's experiments caustic potash in the proportion of 10 per cent. was fatal to pus cocci, and 8 per cent. failed (two hours' exposure). Exposure to the action of a 10 per cent. solution for twenty-hours failed to kill the tubercle bacillus (Schill and Fischer).

Solutions of 1 : 100 kill the anthrax bacillus, the bacillus of rothlauf, and several other pathogenic species (Jaeger).

Soda.—The experiments of Jaeger give caustic soda about the same germicide value as potash. Boer obtained the following results with bouillon cultures exposed for two hours: Anthrax bacillus killed by 1 : 450; diphtheria bacillus, 1 : 300; glanders bacillus, 1 : 150; typhoid bacillus, 1 : 190; cholera spirillum, 1 : 150.

Metallic Salts.

Mercuric Chloride, from a practical point of view, stands at the head of agents of this class, on account of its potency and comparative cheapness. But in using it several important facts are to be kept in view—viz. its poisonous properties; its action upon lead pipes; and the fact that it is decomposed by alkalies, by sulphuretted hydrogen, etc.

The very numerous experiments which have been made with this agent show that its potency is largely influenced by the presence of albumin and of other organic substances in the material to be disinfected. In the article on "Mercuric Chloride" in the report of the Committee on Disinfectants of the American Public Health Association (1885) the writer, from a consideration of the experimental data at hand, arrived at the following conclusion:

"Mercuric chloride in aqueous solution, in the proportion of 1 : 10,000, is a reliable agent for the destruction of micrococci and bacilli in active growth, not containing spores; and in the proportion of 1 : 1000 it destroys the spores of bacilli, provided that the micro-organisms to be destroyed are fairly exposed to its action for a sufficient length of time."

Evidently, if the organisms to be destroyed are enveloped in masses of material which cannot be penetrated by the disinfecting agent, or if the material to be disinfected contains some substance which neutralizes the action of the disinfectant, the object in view will not be attained. Van Ermengen found that the cholera spirillum in bouillon was destroyed in half an hour by 1 : 60,000 mercuric chloride, while a culture in blood-serum required from 1 : 800 to 1 : 1000 to kill this spirillum in the same time. The influence of albumin is shown very clearly by experiments made under the writer's directions by Bolton. Cultures of typhoid bacillus in bouillon were disinfected by exposure for two hours to 1 : 10,000 mercuric chloride solution, but when 10 per cent. of dried egg-albumin was added to the culture medium, the proportion required was 1 : 100.

According to Behring, anthrax bacilli suspended in water are killed in a few minutes by 1 : 500,000 mercuric chloride, in bouillon by 1 : 40,000, while in blood-serum 1 : 2000 was not always successful.

The same author states that two hours' exposure kills the anthrax bacillus, the diphtheria bacillus, and the cholera spirillum in the proportion of 1 : 60,000, but that twice this amount (1 : 30,000) does not suffice for the typhoid bacillus and the bacillus of glanders; while *Staphylococcus pyogenes aureus* requires thirty times as much to ensure sterilization of a bouillon culture. Spores require much stronger solutions, as indicated in the foregoing quotation (1 : 1000). No doubt, as has been pointed out by Geppert, some of the earlier results reported were erroneous, on account of the failure of spores to develop in culture media, owing to the presence of a minute quantity of bichloride which was carried over with them and restrained their growth. Koch has shown that a very minute quantity of bichloride (1 : 300,000) in a culture medium prevents the development of anthrax spores; and Geppert states that spores which have been subjected to the action of this salt without being killed may be prevented from germinating by the presence of 1 part to 2,000,000 of the culture fluid. He found, however, that in the proportion of 1 : 1000 anthrax spores are killed in one hour.

In albuminous liquids solutions of bichloride stronger than 1 : 400 cause a precipitate of albuminate of mercury, but this is soluble in an albuminous fluid, such as blood-serum, and, according to Behring, when dissolved in an excess of albumin is just as active an antiseptic as an aqueous solution containing the same amount of the salt. Albuminous solutions are, however, very unstable, being quickly decomposed by light.

The addition of sodium chloride or of ammonium chloride to solutions of mercuric chloride prevents the precipitation of the salt by albumin, and also causes the solution to be more stable in the presence of light. The precipitation of albumin is prevented by the addition of 5 parts of hydrochloric acid to 1 part of sublimate in the disinfecting solution (Laplace), or by the same amount (5 : 1) of chloride of sodium or chloride of ammonium.

From the experimental evidence recorded, which might have been greatly extended, it is evident that we have in this agent a potent and valuable disinfectant. It is especially applicable for washing surfaces and for the disinfection of soiled linen, etc. In laboratories it is commonly used for the disinfection of old cultures and the vessels in which they have been contained. For these purposes solutions of 1 : 500 or 1 : 1000 are to be recommended. For the disinfection of excreta other agents are to be preferred—chloride of lime, quicklime, carbolic acid.

Cupric Sulphate—Experiments made by the writer and under his direction for the Committee on Disinfectants of the American Public Health Association, gave the following results, the time of exposure being two hours: Recent cultures in bouillon were

sterilized in the proportion stated: Cholera spirillum, 1 : 500; streptococcus of erysipelas, 1 : 500; bacillus of typhoid fever, 1 : 200; *Staphylococcus pyogenes aureus*, 1 : 100. In Dr. Bolton's experiments a 2 per cent. solution failed to kill the spores of the Wurzel bacillus and the bacillus of foul brood, and in the writer's experiments a 20 per cent. solution did not kill anthrax spores. Koch found that a 5 per cent. solution did not kill anthrax spores in ten days.

The germicide action of this salt is greatly limited by the presence of albumin in the material to be disinfected. Thus, Bolton found that when 10 per cent. of egg-albumin was added to a bouillon culture, 1 part to 10 (10 per cent.) was required to kill the typhoid bacillus, while 1 : 200 ($\frac{1}{2}$ per cent.) was effective in simple bouillon cultures.

For the disinfection of material which does not contain spores, and in the absence of any considerable amount of albumin, solutions of 1 per cent. may be recommended.

Silver Nitrate is a very potent germicide and antiseptic, and may be used as such in therapeutics, but is too expensive for general purposes of disinfection. According to Behring, this salt is more potent than mercuric chloride for destroying pathogenic bacteria in blood-serum and other albuminous fluids. The development of anthrax spores in blood-serum was found to be prevented by 1 : 40,000; and the same spores were killed in seventy hours by 1 : 12,000 of an aqueous solution. Anthrax bacilli in blood-serum were killed in twenty hours by 1 : 5000. In bouillon cultures which had been in the incubating oven for twenty-four hours Boer obtained the following results—time of exposure two hours: Anthrax bacillus, 1 : 20,000; diphtheria bacillus, 1 : 2500; glanders bacillus, 1 : 4000; typhoid bacillus, 1 : 4000; cholera spirillum, 1 : 4000.

Chloride of Gold.—Boer reports the following results obtained with chloride of gold and sodium (auro-natriumchlorid) upon bouillon cultures, two hours' exposure: Anthrax bacillus, 1 : 800; diphtheria bacillus, 1 : 1000; glanders bacillus, 1 : 400; typhoid bacillus, 1 : 500; cholera spirillum, 1 : 1000.

Arseniate of Sodium.—Boer reports the following results with this salt, tested upon bouillon cultures, time of exposure two hours: Anthrax bacillus, 1 : 250; diphtheria bacillus, 1 : 500; glanders bacillus, 1 : 250; typhoid bacillus, 1 : 250; cholera spirillum, 1 : 400.

Zinc Chloride.—In the writer's experiments *M. Pasteuri* failed to develop after exposure for two hours to 1 : 200 zinc-chloride solution, but pus cocci required for their destruction 1 : 50. Anthrax spores were not destroyed by two hours' exposure to a 10 per cent. solution. Koch found that anthrax spores germinated freely after being immersed for thirty days in a 5 per cent. solution. The same author found that *M. prodigiosus* grew after sixteen hours' exposure in a 1 per cent. solution.

This salt therefore stands comparatively low as a germicide; it is, however, a valuable antiseptic and deodorant.

Ferrous Sulphate.—In the writer's experiments (1883) a solution of 20 per cent. of this salt failed to kill micrococci and bacilli. Koch found that a 5 per cent. solution did not kill anthrax spores in six days. Jaeger found that a solution of 1 : 30 failed to kill the anthrax bacillus, and 1 : 3 did not destroy anthrax spores; a 10 per cent. solution did not kill the bacillus of glanders. It is evident, therefore, that this salt has no practical value as a disinfectant. It is, however, a valuable deodorant.

Zinc Sulphate.—In Koch's experiments anthrax spores were found to germinate after having been immersed for ten days in a 5 per cent. solution of this salt. In the writer's experiments 20 per cent. failed to destroy pus cocci in two hours.

The following salts have been tested and found to have comparatively little germicide value: Potassium acetate, potassium bichromate, potassium bromide, potassium chlorate, potassium chromate, potassium iodide, potassium nitrate, sodium borate, sodium chloride, sodium hyposulphite.

Coal-Tar Products.

Jaeger has experimented with crude coal-tar, and found that it killed pathogenic bacteria in the absence of spores, but failed to destroy anthrax spores.

Carbolic Acid.—In experiments made by the writer and by Bolton the following pathogenic bacteria in bouillon cultures were killed by two hours' exposure to a 1 per cent. solution of carbolic acid: Cholera spirillum, typhoid bacillus, the pus cocci (*aureus*, *citreus*, and *albus*), the streptococcus of erysipelas. *M. Pasteuri* was killed by 1 : 200, and the same proportion was successful in one experiment with the cholera spirillum, but failed in two others. Boer reports more favorable results, as follows: Anthrax bacillus, 1 : 300; diphtheria bacillus, 1 : 300; glanders bacillus, 1 : 300; typhoid bacillus, 1 : 200; cholera spirillum, 1 : 400. According to Behring, 1 : 200 ensures the destruction of the above-named bacilli when the time of exposure is several hours, and from 1 to $1\frac{1}{2}$ per cent. is required to destroy the same bacilli in a few minutes; but the staphylococci of pus require 2 or 3 per cent. for their destruction in so short a time. It must be remembered that these data refer to pure carbolic acid; the crude acid usually does not contain more than 25 per cent. of phenol.

Tested upon anthrax spores, Koch found a 1 per cent. solution to be without effect after fifteen days' exposure; a 2 per cent. solution retarded the development of spores, but did not destroy their vitality in seven days; and a 3 per cent. solution was effective in two days. At

a temperature of 37.5° C., anthrax spores are killed by a 5 per cent. solution in three hours (Nocht).

The experiments of Laplace show that the addition of hydrochloric acid adds considerably to the germicide value of solutions of carbolic acid: a 4 per cent. solution of crude carbolic acid, containing 2 per cent. of hydrochloric acid, killed anthrax spores in one hour.

Carbolic acid possesses the advantage over mercuric chloride that it is more stable, and that its disinfecting power is not neutralized by substances found in fæces or by the presence of albumin. Thus, Bolton found that the addition of 10 per cent. of dried egg-albumin to a bouillon culture of the typhoid bacillus did not materially influence the result, the bacilli being destroyed in two hours by a 1 per cent. solution.

In view of the evidence recorded, a 5 per cent. solution of carbolic acid is recommended for general purposes of disinfection, and we see no reason to modify the recommendation of the Committee on Disinfectants of the American Public Health Association—viz.:

"Chloride of lime, or bleaching powder, is perhaps entitled to the first place for disinfecting excreta, on account of the rapidity of its action. . . . . A 5 per cent. solution of carbolic acid may be used instead of the chloride-of-lime solution, the time of exposure to the action of the disinfectant being four hours."

Creolin.—This is a coal-tar product which resembles carbolic acid in appearance, but smells more like tar than like phenol. When shaken up with water it forms a milky emulsion. Its chemical constitution is not entirely constant. Numerous experiments have been made to determine its value, and these show that for certain pathogenic bacteria it is a more potent germicide than carbolic acid. Boer reports the following results: Anthrax bacillus, 1 : 5000; diphtheria bacillus, 1 : 2000; glanders bacillus, 1 : 300; typhoid bacillus, 1 : 250; cholera spirillum, 1 : 3000. The results reported by Esmarch are not so favorable. He found that a ½ per cent. solution (1 : 200) was fatal to the cholera spirillum in one minute, but that the same amount did not kill the typhoid bacillus in less than from four to seven days. Anthrax spores were not destroyed in twenty days by a 5 per cent. solution. The tubercle bacillus upon silk threads was killed by a 10 per cent. solution.

The presence of albumin interferes materially with the disinfecting value of creolin. According to Behring, the growth of anthrax bacilli in bouillon is restrained by 1 : 10,000, while in blood-serum 1 : 200 is required; the same bacillus in bouillon is killed by 1 : 5000, in serum by 1 : 100. The emulsion is more active when freshly made than after standing for some time (Behring), and may be used for the destruction of pathogenic micro-organisms, in the absence of spores, in a solution of from 2 to 4 per cent..

Creolin is less poisonous than carbolic acid in the proportion of 1 : 3 (Behring). It is therefore to be preferred for disinfecting the general surface of the body and mucous surfaces. An emulsion of 2 per cent. may be used for this purpose.

Kresol is a dark, brownish-red, transparent fluid, which is somewhat thinner than creolin and has a similar odor. It forms an emulsion with water, which, however, is not as permanent on standing as that formed by creolin. The comparatively high price of this product interferes with its practical value. As a germicide it is more active for spores than either carbolic acid or creolin. When mixed in the proportion of 4 per cent. with an equal quantity of a 4 per cent. solution of sulphuric acid, it kills the spores of anthrax in from eight to twenty hours; meta-kresol, eight hours; para-kresol, ten hours; ortho-kresol, twenty hours (Fränkel). This agent, like creolin, is more effective for the tubercle bacillus than carbolic acid.

Aniline Violet (Stilling's "pyoktanin") has been shown by recent experiments to possess very decided germicide power. According to Boer, bouillon cultures of pathogenic bacilli are sterilized in two hours by the following proportions: Anthrax bacillus, 1 : 5000; diphtheria bacillus, 1 : 2000; glanders bacillus, 1 : 150; typhoid bacillus, 1 : 200; cholera spirillum, 1 : 1000.

Malachite Green is still more active, and destroys the anthrax bacillus in the proportion of 1 : 40,000; the diphtheria bacillus in 1 : 8000; the bacillus of glanders, 1 : 300; the typhoid bacillus, 1 : 300; the cholera spirillum, 1 : 5000.

The experimental data given favor the view that under certain circumstances the germicide power of these aniline colors may have useful therapeutic applications, but they are not likely to have a place as disinfectants for general use.

Naphthol has considerable antiseptic power, although it is insoluble in cold water. It restrains the development of various micrococci and bacilli in bouillon when present in the proportion of 0.1 per 1000 (Maxinovitch). On account of its insolubility and non-poisonous properties it is a valuable antiseptic for internal administration, but it is not available as a disinfectant.

Thymol has comparatively little germicide value. According to Behring, it is one-fourth as active as carbolic acid. In the experiments of Cadéac and Meunier it killed the bacillus of typhoid fever after thirty-five minutes' contact.

Essential Oils.

Although there are no disinfectants of practical importance in this class, it will be of interest to know the comparative value of these agents. This has been investigated by Cadéac and Meunier, who

experimented with several different pathogenic bacteria: we shall give only the results obtained with one—the bacillus of typhoid fever:

Essences which kill the microbe after a contact of less than twenty-four hours:

Oil of cinnamon of Ceylon	12 minutes.
Oil of cloves	25 "
Thymol	35 "
Oil of thyme	35 "
Oil of verbena	45 "
Oil of geranium, French	50 "
Oil of patchouly	80 "
Oil of wormwood	4 hours.
Oil of santal	12 "
Oil of cedar	22 "

"The following required more than twenty-four hours: Cumin, valerian, lemon, sapine, pepper, turpentine, rose, camomile. The following more than two days: Sassafras, tuberose, coriander. The following more than six days: Savine, fenil, mace, sage, peppermint, mustard, anise, eucalyptus, cajeput, wintergreen, camphor, and some others."

Chloroform.

The researches of Kirchner and others show that chloroform has valuable germicide properties, which make it desirable that this agent should receive mention, although it is not likely to be used for general purposes of disinfection. The cholera spirillum is killed in less than a minute by a saturated aqueous solution (1 per cent.), and in one hour by a $\frac{1}{4}$ per cent. solution; the typhoid bacillus in one hour by a $\frac{1}{2}$ per cent. solution (Kirchner). In view of the results of his experiments Kirchner recommends the disinfection of drinking-water which is suspected of being contaminated by the germs of cholera or typhoid fever, by the use of this agent. But it is so much simpler to use heat that this suggestion will scarcely be acted upon, especially as heat would be required to rid the water of the chloroform promptly before using it for drinking purposes. The suggestion that it would constitute a useful wash for disinfecting the mouth has more value.

Having briefly passed in review the experimental data relating to the comparative value of disinfectants, we desire to call attention to the fact that *for certain purposes an antiseptic may in practice be substituted for a disinfectant*, properly so called. By an "antiseptic" we mean an agent which prevents septic decomposition by preventing the development of the micro-organisms which cause it; and we extend the use of the term to the restraining influence exercised upon other micro-organisms of the same class, including the pathogenic bacteria, or "germs" of infectious diseases. Disinfectants are also antiseptics,

and usually in considerably less amount than is required to disinfect. We give below the value of various antiseptics, as obtained by Miquel, the proportions being that in which the agents named permanently prevented the development of any of the micro-organisms floating in the atmosphere; *i. e.* the organic solution was freely exposed to the air, and the test consisted in its permanent preservation from putrefactive changes. If Miquel had protected his solutions from atmospheric organisms and inoculated them with pure cultures of certain pathogenic bacteria—*e. g.* the anthrax bacillus or the cholera spirillum—the results would have been still more favorable, and after a time, which would be different for different bacteria, he would have found that the pathogenic bacteria introduced into his culture media had lost their ability to grow in a favorable medium; in other words, that the antiseptic agent had in the end sterilized or disinfected his organic solution. The same thing may occur in a latrine into which the excreta of cholera or typhoid patients have been thrown. If an antiseptic agent is added in sufficient quantity to prevent the multiplication of the cholera spirillum or typhoid bacillus, these will practically be rendered harmless, and after a time will lose their vitality. So too in therapeutics: if we can restrain the development of a pathogenic bacillus, we practically render it harmless, or at least restrict its power for mischief within limits which are compatible with the safety of the patient.

Miquel's results are classified as follows:

Substances eminently antiseptic:

	Efficient in the proportion of—		Efficient in the proportion of—
Mercuric iodide	1 : 40,000	Mercuric chloride	1 : 14,300
Silver iodide	1 : 33,000	Silver nitrate	1 : 12,500
Hydrogen peroxide	1 : 20,000		

Substances very strongly antiseptic:

Osmic acid	1 : 6666	Hydrocyanic acid	1 : 2500
Chromic acid	1 : 5000	Bromine	1 : 1666
Chlorine	1 : 4000	Cupric chloride	1 : 1428
Iodine	1 : 4000	Thymol	1 : 1340
Chloride of gold	1 : 4000	Cupric sulphate	1 : 1111
Bichloride of platinum	1 : 3333	Salicylic acid	1 : 1000

Substances strongly antiseptic:

Benzoic acid	1 : 909	Lead chloride	1 : 500
Potassium bichromate	1 : 909	Nitrate of cobalt	1 : 476
Potassium cyanide	1 : 909	Sulphate of nickel	1 : 400
Muriate of quinine (Ceri)	1 : 900	Nitrate of uranium	1 : 356
Aluminium chloride	1 : 714	Carbolic acid	1 : 333
Ammonia	1 : 714	Potassium permanganate	1 : 285
Zinc chloride	1 : 526	Lead nitrate	1 : 277
Mineral acids	1 : 500–1 : 333	Alum	1 : 222
Thymic acid	1 : 500	Tannin	1 : 207

Substances moderately antiseptic:

Bromhydrate of quinine	1 : 182	Hydrate of chloral	1 : 107
Arsenious acid	1 : 166	Salicylate of sodium	1 : 100
Boric acid	1 : 143	Ferrous sulphate	1 : 90
Sulphate of strychnine	1 : 143	Caustic soda	1 : 56
Arsenite of sodium	1 : 111		

Substances feebly antiseptic:

Protochloride of manganese	1 : 40	Strontium chloride	1 : 12
Calcium chloride	1 : 25	Lithium chloride	1 : 11
Sodium borate	1 : 14	Barium chloride	1 : 10
Muriate of morphine	1 : 13	Alcohol	1 : 10

Substances very feebly antiseptic:

Ammonium chloride	1 : 9	Glycerin (sp. gr. 1. 25)	1 : 4
Potassium arsenite	1 : 8	Ammonium sulphate	1 : 4
Potassium iodide	1 : 7	Sodium hyposulphite	1 : 3
Sodium chloride	1 : 6		

It will be noticed that sodium chloride, which is probably more extensively used as an antiseptic than any other agent, comes nearly at the foot of the list when we consider its comparative antiseptic value, yet on account of its cheapness and non-toxic properties it is likely to maintain its position for the preservation of meats, etc. But we have experimental data showing that pathogenic bacteria which are present in salted meats may preserve their vitality for a long time: this is especially true of the tubercle bacillus, which has exceptional resisting power to disinfecting agents, and could hardly be expected to be destroyed by so feeble an antiseptic.

The difference between an antiseptic and a disinfectant is well illustrated by such an agent as thymol, which stands above carbolic acid as an antiseptic, and yet has, according to Behring, one-fourth the value as a disinfectant. The difference is still more marked in the case of hydrogen peroxide, which Miquel places very high in the list of antiseptics, and which has comparatively little germicide value.

In conclusion, we give below a list of the most useful disinfecting agents, as determined by exact experiment, together with some indications as to the special purposes for which they are best adapted:

For Infectious Material which contains Spores.—(The following known pathogenic bacteria form spores: the bacillus of anthrax, of tuberculosis, of tetanus, of malignant œdema, of symptomatic anthrax.)

Moist Heat.—Free exposure in boiling water or "live steam" (100° C.) for half an hour. Effective for all kinds of infectious material.

Mercuric Chloride.—Add to standard solutions 5 parts of sodium chloride, or of ammonium chloride, or of hydrochloric acid, to

1 part of corrosive sublimate. For washing surfaces and as a disinfectant for soiled linen, etc. use a solution of 1 : 500. For repeated or continuous application to the surface of the body use solutions of from 1 : 1000 to 1 : 3000.

Chloride of Lime should contain at least 25 per cent. of available chlorine. Dissolve 6 ounces in a gallon of water (50 grams to the litre). Use a quart of this solution for disinfecting an ordinary liquid discharge from the bowels in cases of typhoid fever, cholera, or tuberculosis. Also useful for disinfecting vomited matters and sputa.

For the Destruction of Pathogenic Bacteria which do not form Spores.—(The following belong to this class: the streptococcus of erysipelas, the diplococcus of pneumonia, the pus cocci, the micrococcus of gonorrhœa, the bacillus of diphtheria, the bacillus of typhoid fever, the bacillus of glanders, the bacillus of rouget, the bacillus of fowl cholera, the spirillum of cholera.) Use the agents above referred to or the following:

Dry Heat.—Free exposure for two hours to a temperature of 130° C. (266° F.). For clothing and other articles which would be injured by steam or hot water.

Carbolic Acid.—A solution of 5 per cent. may be used as a disinfecting wash for clothing, for surfaces, etc. The addition of 2 per cent. of hydrochloric acid adds considerably to the disinfecting power of the solution. For excreta use a quart or more of a 5 per cent. solution for each liquid discharge, and leave for four hours before throwing out.

Creolin.—An emulsion containing 5 per cent. may be used instead of carbolic acid.

Mineral Acids.—Sulphuric, hydrochloric, or nitric acids may be used for the disinfection of excreta. A 4 per cent. solution, added in equal amount to the material to be disinfected, and left in contact with it for two hours, will be effective.

Milk of Lime.—Made from freshly-burned lime by mixing the hydrate with water in the proportion of 1 part to 8 by weight. This may be used for disinfecting the contents of latrines by adding it in the proportion of 5 parts to 100 parts of the contents of the vault, and the daily addition of 10 parts for every 100 parts of daily increment. When used to disinfect excreta in the sick-room a prolonged contact will be required—twelve hours. Very valuable as an application to walls of plaster or wood.

Sulphurous Acid.—When sulphur dioxide comes in contact with pathogenic bacteria in the presence of moisture sulphurous acid is formed, and this is a valuable disinfecting agent. But anhydrous sulphur dioxide has very little germicide power. When, therefore, "fumigation" with this gas is employed with a view to disinfect hospital

wards, ships, etc., the objects and surfaces to be disinfected should be wet, or steam should be introduced into the closed apartment together with the sulphur dioxide. We quote below the directions of the Committee on Disinfectants of the American Public Health Association:

"To ensure any results of value it will be necessary to close the apartment to be disinfected as completely as possible by stopping all apertures through which the gas might escape, and to burn not less than 3 pounds of sulphur for each 1000 cubic feet of air-space in the room. To secure complete combustion of the sulphur, it should be placed in powder or in small fragments in a shallow iron pan, which should be set upon a couple of bricks in a tub partly filled with water, to guard against fire. The sulphur should be thoroughly moistened with alcohol before igniting it."

Bibliography.

Koch, R.: "Ueber Desinfection," *Mittheilungen aus dem Kaiserl. Gesundheitsamte*, 1881.

Koch and Wolffhügel: "Untersuchungen über die Desinfection mit heisser Luft," *Ibid.*, 1881.

Koch, Gaffky, and Löffler: "Versuche über die Verwerthbarkeit heisser Wasserdämpfe zu Desinfectionszwecken," *Ibid.*, 1881.

Sternberg, G. M.: "Experiments designed to Test the Value of Certain Gaseous and Volatile Disinfectants," *National Board of Health Bulletin*, Wash., vol. i., 1879-80.

Sternberg, G. M.: "Experiments with Disinfectants," *Johns Hopkins Univ. Studies in the Biol. Lab.*, Balt., 1882 (vol. ii. No. 2).

Sternberg, G. M.: "Experiments to Determine the Germicide Value of Certain Therapeutic Agents," *Am. Jour. of the Med. Sciences*, April, 1883.

Sternberg, G. M.: "The Thermal Death-point of Pathogenic Organisms," *Am. Jour. of the Med. Sciences*, Phila., 1887, N. S. xciv.

Disinfection and Disinfectants. Reports of the Committee on Disinfectants appointed by the American Public Health Association. Published by the Association, Concord, N. H., 1888.

Behring: "Ueber Quecksilbersublimat in eiweisshaltigen Flüssigkeiten," *Centralblatt für Bact. und Parasitenkunde*, 1888.

Behring: "Ueber Desinfection, Desinfectionsmittel, und Desinfectionsmethoden," *Zeitschrift für Hygiene*, Bd. ix. Heft 3, 1890.

Pfuhl, E.: "Ueber die Desinfection der Typhus und Choleraausleerungen mit Kalk," *Zeitschrift für Hygiene*, Bd. vi., 1889.

Jaeger, H.: "Untersuchungen über die Wirksamkeit verschiedener Chemischer Desinfectionsmittel bei Kurz dauernder Einwirkung auf Infectionsstoffe," *Arbeiten aus dem Kaiserl. Gesundheitsamte*, 1889.

Geppert, J.: "Zur Lehre von den Antisepticis," *Berl. klin. Wochenschrift*, 1889, No. 36.

Schottelius, M.: "Vergleichende Untersuchungen über die desinficirende Wirkung einiger Theerproducte," *Münchener med. Wochenschrift*, 1890, No. 20.

Stilling, J.: "Anilinfarbstoffe as Antiseptica und ihre Anwendung für die Praxis," Strassburg, 1890.

Kirchner, M.: "Untersuchungen über die Einwirkung des Chloroforms auf die Bacterien," *Zeitschrift für Hygiene*, Bd. viii., 1890.

Boer, O.: "Ueber die Leistungsfähigkeit mehrerer chemischer Desinfectionsmittel

bei einigen für den Menschen pathogenen Bacterien," *Zeitschrift für Hygiene*, Bd. ix., 1890.

KITISATO, S.: "Ueber das Verhalten der Typhus und Cholerabacillen in säure und alkalihaltigen Nährböden," *Zeitschrift für Hygiene*, Bd. iii., 1888.

CADÉAC AND MEUNIER: "Récherches expérimentelles sur l'Action antiseptiques des Essences," *Annales de l'Institut Pasteur*, 1889.

MIQUEL, M. P.: "Les Organismes vivantes de l'Atmosphère," chap. ix. pp. 289–299, Paris, 1883.

NISSEN, F.: "Ueber die desinficirende Eigenschaft des Clorkalks," *Zeitschrift für Hygiene*, Bd. viii., 1890.

RIEDEL, OTTO: "Versuche über desinficirende und Antiseptische Eigenschaften des Iodtrichlorids, wie über dessen Giftigkeit," *Arbeiten aus dem Kaiserl. Gesundheitsamte*, 1887.

LAPLACE, E.: "Säure Sublimat—Lösung als desinficirendes Mittel und ihre Verwendung in Verbandstoffen," *Deutsche med. Wochenschrift*, Leipzig, 1887, xiii. 866.

BEHRING: "Der antiseptische Werth der Silberlösungen und Verhandlung von Milzbrand mit Silberlösungen," *Deutsche med. Wochenschrift*, 1887, Nos. 37 and 38.

WOLFFHÜGEL, G.: "Ueber den Werth der schwefligen Säuer als Desinfectionsmittel," *Mittheilungen aus dem Kaiserl. Gesundheitsamte*, 1881, Bd. i.

HENLE, A.: "Ueber Creolin und sein wirksame Bestandtheile," *Archiv für Hygiene*, 1889, Bd. ix.

SCHILL AND FISCHER: "Ueber die Desinfection des Auswurfs der Phthisiker," *Mitth. a. d. Kaiserl. Gesundheitsamte*, Bd. ii., 1882.

YERSIN: "Action de la Chaleur sur le Bacille tuberculeux," *Ann. de l'Institut Pasteur*, t. ii. p. 60.

ALTEHOEFER: "Ueber die Desinfektionskraft von Wasserstoffsuperoxyd auf Wasser," *Cent. für Bak. und Parasitenkunde*, Bd. viii. p. 129.

JEROSCH: "Experimentelle Untersuchungen über die desinficirenden Wirkungen von Höllensteinlösungen," *Cent. f. Bak. und Parasitenkunde*, Bd. vii. 226.

SONNTAG, H.: "Ueber die Bedeutung des Ozons als Desinficiens," *Zeit. f. Hyg.*, Bd. viii. 1890.

SPILKER AND GOTTSTEIN: "Ueber d. Vernichtung von Mikroorganismen durch die Induktionselektricität," *Cent. f. Bak. und Parasitenkunde*, Bd. ix. 1891.

ANTISEPSIS AND ASEPSIS.

By J. WILLIAM WHITE, M. D.

"La chirurgie antiseptique est avant-tout une question de doctrine. Une fois que le chirurgien possède bien cette doctrine, il pourra appliquer partout et avec le matériel le plus variable, le plus divers, et le plus simple, une méthode fondamentale."—LUCAS-CHAMPIONNIÈRE.

THE labors of Schwann and Pasteur, crowned by the experimental investigations and clinical work of Lister, have placed the theory of antisepsis in relation to surgery upon a perfectly secure foundation, but its application in detail is so intimately associated with the principles involved that a brief review of the latter seems essential in a consideration of the subject from the therapeutic standpoint.

Antiseptic surgery is directed against the causes of putrefaction in wounds and their discharges. Putrefaction is a form of fermentation accompanied by the development of offensive odors. Instances of fermentation are seen in the action on amygdalin of emulsin, the former being broken up into various products, chiefly hydrocyanic acid and oil of bitter almonds, the emulsin remaining unchanged, though its presence is necessary for the chemical action. Pepsin, ptyalin, and pancreatin act in the same way. They undergo little or no change, and are known as the chemical ferments. As surgeons it is not with this class of ferments that we have to deal. There is another series which does not act suddenly in this manner, but slowly and steadily, and which possesses the power of self-multiplication. This is seen in the alcoholic fermentation. A minute piece of yeast-plant introduced into a sugary solution is multiplied and goes on acting until the sugar is decomposed with the formation of alcohol and carbonic acid. This form of putrefaction is a property of living things, and hence these ferments are called the vital ferments. In the putrefaction of discharges in wounds we have to deal with ferments of this class, as we do likewise in the fermentation or "spoiling" of all animal fluids and tissues. The cause of this fermentation has been variously explained. It was thought for some time to be an inherent property of such fluids and tissues, and later it was said to be due to the action of oxygen upon them. The first theory was exploded when it was demonstrated experimentally that animal substances protected from atmospheric contamination could

be preserved indefinitely; and the second was shown to be fallacious when it was proved that air could be admitted freely without harmful results, provided it were first acted upon in certain ways. If we take, for example, a flask of beef-tea or of urine, two of the most decomposable and putrescent animal fluids, and boil them so as to expel all air from the flask, and then allow that which re-enters as the flask cools to pass first through a layer of nitric or sulphuric or carbolic acid, or through a strong solution of corrosive sublimate, or even to filter through a plug of cotton wool introduced into the neck of the flask, we find that the oxygen of the air can come freely in contact with the fluids without interfering with their complete preservation. If the air which re-enters is simply made to pass slowly through a long curved tube, so that the dust which the atmosphere contains, and the larger particles of which may be seen dancing in every ray of sunlight, can have an opportunity to settle, we also ensure the thorough protection of the fluids from decomposition. These experiments not only disprove the theories which attributed putrefaction to the essential qualities of organic substances or to the contact with oxygen, but at the same time demonstrate that the cause of putrefaction is not a gas of any sort, but something particulate, heavier than air, and probably organic, as it is completely destroyed by heat and by substances, such as carbolic acid, which exert but little influence on inorganic bodies.

Examples taken from pathology illustrate the strikingly similar behavior of the fluids and tissues within the body when similarly protected from contamination. The differences which used to exist between simple and compound fractures when the latter were treated without antiseptic precautions; the history of subcutaneous surgery; the remarkable contrast between the process of gangrene or mortification occurring on the surface of the body and the same process following thrombosis or embolism in an internal organ; the change in the character of the pus of a cold abscess after evacuation or spontaneous opening has exposed it to atmospheric contamination,—these and numberless other examples emphasize sufficiently the principle that within the body, as without, putrefaction depends upon the presence of certain microorganisms.

The claim that pathogenic bacteria are constantly to be found in the blood and tissues of the healthy living body, which is used as an argument against the antiseptic theory, is not substantiated either by the results of careful microscopical research or by those of clinical observation.

There can be no doubt that pathogenic microbes do now and then gain access to the tissues of a healthy organism; but they are immediately and almost invariably eliminated by the excretory organs or destroyed by the action of the cells and fluids of the body. The

interesting fact that osteo-myelitis occurs in a simple fracture after micrococci have been injected into the circulation, although previously such germs as were present in the blood and elsewhere exerted no influence, marks the difference between the occasional and accidental admission of the bacteria of disease into a healthy body, and the effect of an increased dose of such microbes upon an organism in which there has been established a *locus minoris resistentiæ*. It is to avoid the introduction of these microbes that the efforts of antiseptic surgery are directed. Septic dust containing them is present on all objects in the external world, as the skin of the patient, the hands of the surgeon, the instruments used. Contamination through the atmosphere alone is also possible, though less probable. When a wound is made any introduction of this dust must be carefully avoided. Then after the wound is made great care must be taken to prevent its entrance during the subsequent treatment. Some sort of dressing must be provided which shall render its passage in an active state impossible, and at every change of this dressing the problem is the same as at the time of the infliction of the wound.

Before considering the details of the plan by which this is to be accomplished, we must first investigate the relation which putrefaction has to the various diseases associated with wounds and which have caused such terrible mortality, chiefly pyæmia, septicæmia, and erysipelas. These are the great causes of death after operation, and are the maladies against which the whole armamentarium of aseptic surgery is directed. Fortunately, but only incidentally, suppuration, inflammation, and fever are also prevented by asepticism, but the most engrossing labors of modern surgery are directed to the prevention of these wound diseases. We have seen, beyond a doubt, both experimentally and clinically, that putrefaction is a form of fermentation, and that fermentation is due to the growth of micro-organisms in organic fluids or tissues, whether they are confined in a living body or are external to it; and we know that the particles which cause such putrefaction or other fermentation only rarely enter the tissues through the circulation, but almost invariably reach them directly from the air or from surrounding objects. Now, it is of no importance for our present purpose —which is to establish the therapeutic relation of antisepsis to wound diseases—whether we do or do not believe in the germ theory of infective disease—whether, in other words, we do or do not believe in the theory that pyæmia and septicæmia are due to the entrance into the blood of the same germs which produce putrefaction in the fluids and tissues, or to some products which arise during the process of putrefaction, or to something else which is entirely distinct. The evidence in favor of the germ theory of putrefaction itself is simply overwhelming; and to demonstrate its value to surgery it only

remains for us to show distinct relations between putrefaction in wounds and the occurrence of pyæmia, septicæmia, erysipelas, and the lesser wound diseases which have been mentioned. Microscopical evidence has of late years rapidly accumulated in this direction, and the existence of certain forms of bacteria or micrococci can be demonstrated with almost absolute certainty in the discharges from all forms of infected or unhealthy wounds. Equally conclusive and much more striking proofs may be presented in the shape of the clinical results of some of the most renowned surgeons of the world.

A fair comparison of such results, obtained in large numbers of cases, is the most logical way of demonstrating the relation between pyæmia and septicæmia and the admission of micro-organisms to wounds. Certain factors are necessary for the production of blood-poisoning in addition to the admission of bacteria, but the latter is the essential agent in causing the infection of the system and the above-mentioned diseases. By looking back a few years to the very beginning of the employment of antiseptic methods we can obtain striking evidence of the effect of treatment directed almost exclusively, though then very imperfectly, against the introduction of bacteria. The record of the work of Professor Lister may well begin our series of examples: In Glasgow, in 1864, 1865, 1866, Mr. Lister's mortality in a series of operations of all sorts was 45.7 per cent., largely from septic diseases. About this time he began to employ, gradually, some antiseptic methods in his treatment of wounds and during operations. In 1867, 1868, 1869, his mortality fell to 15 per cent. At Edinburgh, having greatly improved—indeed almost perfected—the details of his system, we find that from 1871 to 1887 he treated 553 grave surgical cases with a mortality from septic disease of only .36 per cent.—a diminution in the death-rate which, when we remember that these different results were obtained by the same man operating upon the same class of patients and for the same injuries or diseases, is so striking as to be in itself conclusive. In London, still later, an opportunity was afforded to compare Mr. Lister's results with those of a colleague, Mr. Spence, working in the same hospital, but declining to employ aseptic methods. The total results of their major operations showed that Mr. Spence lost just about three patients where Mr. Lister lost one, while the deaths from infective diseases were 2.4 per cent. among Spence's cases, and $\frac{1}{3}$ of 1 per cent., or eight times less, among those of Mr. Lister. When we turn to the work of other surgeons we find evidence, if possible, still more conclusive of the value of these methods. Nussbaum has shown that for forty years in his clinic, under his own direction as well as that of his predecessors, among whom was Stromeyer, the deaths from wound diseases were so common that patients with even the slightest injuries often succumbed to them; that erysipelas

and abscesses were matters of daily occurrence; that 80 per cent. of all wounds and sores were attacked with hospital gangrene, and that nearly all patients with compound fractures died; and he states that immediately upon the introduction of the antiseptic system all these diseases vanished, and healing by first intention, previously almost unheard of in his service, became the rule instead of the exception. Professor Volkmann, in an address before the International Medical Congress which met in London in 1881, selected two examples especially, compound fractures and major amputations, as evidence of the value in his hands of the antiseptic method. He said that the mortality after compound fracture had, during the long labors of the surgeons who preceded him as well as during his own, reached the sad height of 40 per cent. When he adopted the antiseptic method of treating wounds his last twelve patients with compound fracture of the leg had all died of pyæmia or septicæmia. From that time up to the period at which he delivered this address he had treated one after another 135 compound fractures without losing a single patient from either of these wound diseases; 133 were cured, 2 died—1 of fatty embolism of the lungs during the first few hours, and 1, a drunkard, of delirium tremens. As to the amputations, he asserted that he now cured each year with the antiseptic method more cases of amputation of the thigh, for example, than during all the rest of his labors before the introduction of that method. In an article on the treatment of compound fractures Professor Dennis of New York has compiled further evidence in this same direction. In the Pennsylvania Hospital between the years 1839 and 1851 there were treated 116 cases of compound fracture of the leg and thigh; excluding those cases requiring amputation, there were 51 deaths, a mortality of 45 per cent. In the New York Hospital during the same period there were treated 126 cases of compound fracture of the leg and thigh; excluding amputations, there were 61 deaths, a mortality of 48 per cent. From 1860 to 1876 there were reported from the surgical clinics of Vienna and Zurich by Billroth 180 cases of compound fractures; excluding amputations, there was a mortality of 41 per cent. from septic disease. In the Obuchow Hospital reports of St. Petersburg 106 cases of compound fracture gave a mortality of 68 per cent. In Guy's Hospital from 1841 to 1861 there were reported 208 cases of compound fracture, with 56 deaths, a mortality of 26 per cent. After the general introduction of antisepsis this death-rate immediately fell to 4 per cent. from an average of from 40 to 50 per cent., and in this article of Dr. Dennis's, in which he reports 516 cases of compound fractures, there was no record of death from septic trouble in any fracture of the extremities, which was the class of injuries included in the above statements. I might easily multiply such evidence as this, but the subject has passed beyond the

controversial stage, and I may therefore omit further statistical matter.

We may consider it as proven that there is a definite and distinct relation between the entrance into wounds of bacteria whose vitality has not been destroyed by antiseptic measures and the occurrence of certain septic diseases. As to the definite etiological relation of particular micro-organisms to specific diseases, this is also in many instances far beyond dispute. The evidence necessary to warrant this statement is as follows: The organism must be distinctly recognizable at different periods of its growth; it must be isolable; it must be capable of cultivation alone, and free from association with other organisms; it must be invariably associated with the disease in question; it must be capable by inoculation of producing that disease; it must retain this power through an indefinite series of cultures.

At least five well-known examples may be mentioned of indisputable relation of cause and effect between specific pathogenic microbes and infective disease. Since 1879, when Koch first demonstrated the connection between definite micro-organisms and various wound diseases, the evidence has steadily accumulated. Ogston in 1881, Rosenbach and Cheyne in 1884, Passet in 1885, Zuckermann in 1887, have shown that the various staphylococci have a distinct causative relation to acute suppuration. They can be found in and cultivated from the pus in every recent abscess; they invariably produce suppuration when pure cultures are injected, even to the twentieth generation. Their effect may or may not be aided by the ptomaïnes which they produce, but as the amount of ptomaïnes is directly proportionate to the number of microbes present, and as the ptomaines are never produced at all in the absence of the microbes, the question as to the relative importance of the two has, as Senn long ago said, but little interest for the practical surgeon. Another example is to be found in malignant pustule, the specific cause of which, the bacillus anthracis, is readily cultivated in different media, and produces the disease when inoculated in the smallest possible quantity. Fehleisen in 1883 showed that erysipelas depended upon a streptococcus, inoculation of which when quite pure produced the disease in 6 out of 7 cases, the exception occurring in a person who had recently had an attack of erysipelas and was scarcely more than convalescent. Acute osteo-myelitis has until recently been thought to be due to the ordinary microbes of suppuration, but the researches of Becker and Krause (1883) and others have made it probable that a specific micrococcus is the essential element of the disease. Tubercle furnishes the last and perhaps the most important of our examples of microbic disease.

It is apparent that in the face of this evidence the surgeon who hopes not only to escape wound diseases, but who aims at absence of

suppuration and at union by first intention in all his operation cases, must carefully review every detail of his method. It is not sufficient merely to employ in and about the wound an antiseptic of sufficient strength to ensure destruction of the germs. The problem is not so simple; other factors must be taken into consideration.

The general vitality of the patient is of considerable importance, as healthy living tissues have in themselves a great power of resistance to the growth and multiplication of micro-organisms. This preventive influence is well seen in wounds about the face, where, on account of the great vascularity of the region, healing occurs with exceptional rapidity, even if no aseptic precautions have been taken, provided that there has been accurate coaptation of the cut surfaces. As this resistant influence of the body does not extend through thick layers of tissue or of blood or lymph, it follows that in aiming to secure accurate and exact approximation of the surfaces of wounds we are simply observing a minor antiseptic precaution.

The operator has thus a twofold duty—viz. to prevent the entrance of living pathogenic microbes into the wound, and at the same time to preserve the vitality of the tissues themselves. The phagocytic theory of Metchnikoff [1] is a recognition and attempted explanation of this property of healthy tissues. Waterhouse's experiments [2] and clinical experience have demonstrated the anti-bacteric power of the peritoneum. Bouchard and others have observed the destruction of bacilli by the spleen and their elimination by the kidneys, as in typhoid fever. Buchner and Lubarsch [3] have shown the bactericidal power of blood-serum or of some substance, such as the fibrin-ferment, contained therein. We have abundant reason, therefore, to believe in a general antagonism between the body-cells and the micro-organisms of disease, even if we consider the question of phagocytosis as still an open one. It follows that the theoretical propriety of non-interference with these tissues cannot be doubted; and Lister has recently admitted and accepted this view, remarking that the floating particles of the air having been shown to be less harmful than was supposed, we may possibly dispense with antiseptic washing and irrigation, "provided always that we can trust ourselves and our assistants to avoid the introduction into the wound of septic defilement from other than atmospheric sources."

So, too, in regard to drainage. A certain amount of moisture is necessary for the occurrence of putrefaction, the micro-organisms upon which it depends failing to live and multiply in wound discharges which are very scanty or very concentrated. We meet this indication by a careful arrangement of catgut or rubber, bone, or glass drainage-

[1] *Fortschritte der Medizin*, Bd 2, 1884, No. 17.
[2] *Virchow's Arch.*, Bd. 119, Heft 3, p. 342.
[3] *Versammlung Deutsch. Naturforsch. und Aerzte*, Heidelberg, 1889.

tubes to withdraw all superfluous matter from wounds. Elevation of the affected part by diminishing the blood-supply and lessening the blood-pressure, together with firm uniform compression by bandages, is a means to the same end. Bearing in mind the importance of these auxiliary measures, attention to the general vitality, careful arrest of hæmorrhage, removal of wound secretion by drainage, and accurate approximation of cut surfaces, etc., we may now consider the means by which we avoid the introduction of micro-organisms or render them harmless after they are introduced. Miquel has found that in the ordinary atmosphere of a large city there are two thousand bacteria to the cubic yard, the air of a room or an old house in winter showing forty-five thousand to the cubic yard, while the wards of a long-used hospital show ninety thousand germs in the same space; he has also called attention to the interesting fact that sea-air and that of mountain-heights is nearly free from them; which would explain in itself the excellent results obtained in surgical cases operated upon in such localities. Of course, all these micro-organisms are not infectious, and, as we have seen, it has been shown that there are probably a few species which are chiefly active in producing septic diseases and suppuration; notably, *Staphylococcus pyogenes aureus* and *albus*, the streptococcus of erysipelas, and various others with which we are at present less familiar. It is possible that there is a distinct germ for each form of infective disease, or that, on the other hand, the variations observed in these diseases are due to varying local and general conditions. They obtain entrance to wounds either by falling into them from the air, or much more frequently through the medium of the hands and instruments of the surgeon and his assistants. They exist upon the skin and upon the hypodermic scales of all persons, and are found in large numbers in dust and dirt of all kinds.

When we consider the details of any antiseptic method, we must begin with purification of the hands of all persons who will have to approach the wound, as well as of the skin of the patient in the region of operation. Kümmel, Koch, and others have repeatedly shown that ordinary methods of cleansing and disinfecting are imperfect and unreliable, especially washing with soap and water, which should be employed as a preparatory measure, but cannot be depended upon to produce either in hands or instruments a truly aseptic condition. Nor can the ordinary employment of carbolic or sublimate solutions be relied upon absolutely. Experimental microscopic researches made by the above-named German investigators have demonstrated that after washing the hands thoroughly in soap and water, and then dipping them into 1 : 1000 sublimate solution or 1 : 20 carbolic solution, they still carried into sterilized gelatin nests of bacteria which would set up putrefactive changes. This was thought to be due to

the presence of oily matters upon the surface of the skin which prevented the antiseptic solutions from penetrating into the minute irregularities, particularly in the periungual and subungual spaces. It was therefore thought probable that the use of alcohol or ether subsequently to the scrubbing with soap and water might remove this difficulty; and, the experiment being tried, such was found to be the case.

I will therefore, in describing the details of an antiseptic operation, begin by instructing you to scrub the hands thoroughly with soap and warm water to remove the bulk of foreign matters. Then clean the spaces beneath and around the nails; soak the hands in 95 per cent. alcohol for not less than one minute; on removing them place them without drying in a solution of 1 : 1000 corrosive sublimate, and allow them to remain there for at least one minute. They should be wet at the time of beginning the operation, and should be kept wet during the operation, either by means of the fluid used in irrigating or by frequently dipping them into the antiseptic solution preferred. The skin of the region to be operated upon should be treated in the same manner—first with soap and water, then with alcohol or ether (preferably the former, on account of its greater antiseptic power), and finally with corrosive sublimate or carbolic solution, or the solution now used by Lister of 1 : 20 carbolic in 1 : 500 bichloride. If this procedure can be employed some hours before the operation, and the part in the mean time be kept covered with towels wet with bichloride, a more thorough penetration of the skin is secured and a diminished liability of carrying bacteria from it into the depths of the wound during the operation. It is sometimes well to have it more or less continuously irrigated with warm antiseptic solutions, but this can generally be dispensed with.

In cases of abdominal surgery it is especially undesirable to bring large quantities of more or less irritating fluids into contact with the peritoneum. Even here, however, the greatest success is obtained by modifications of these methods. In addition to perfect cleanliness special attention should be directed to keeping the wound in the abdominal wall (which is made as small as possible) well covered by wet towels or sponges during the necessary manipulations.

Where a joint, such as the knee, is opened, the use of the strong sublimate solution, which is seriously irritating to the synovial membrane, should be avoided; and in that case it is better to irrigate through the whole operation with 1 : 4000. As to rendering wounds aseptic which have been infected, that is, speaking generally, a thing on which we can never reckon with absolute certainty; in recent wounds, like compound fractures, the chance of success is, of course, always greater the shorter the time that has elapsed after the infliction of the injury.

If the skin and wound are greasy, oil of turpentine is of great value

for cleaning away the dirt, and the use of a nail-brush with carbolic and sublimate solutions after the turpentine (or without it if there be no special occasion for its use) is very valuable. In many cases where septic sinuses are present it is hopeless to try to extirpate the septic mischief; but very great advantage is gained by washing the cut surfaces in an operation under such circumstances with a solution of chloride of zinc, forty grains to the ounce of water. This is done once for all at the conclusion of the operation, and prevents putrefaction during the critical early days. The same solution is used where the wound communicates with a septic cavity, as after the removal of a portion of a tongue or of a jaw; and under these circumstances it is also useful to apply iodoform to the cut surface after the chloride. In cases in which the septically infected part is of very limited extent—as, for example, where a suppurating strumous gland has discharged without an antiseptic dressing—complete disinfection may often be obtained by applying undiluted liquid carbolic acid after scraping away the degenerated glandular or other tissue with a sharp spoon.

I have recently learned to value peroxide of hydrogen very highly as an antiseptic, especially in suppurating cases, and am using it more largely than ever before.

In arresting hæmorrhage it will be necessary to employ a material which, while thoroughly aseptic, can be left in the wound with the certainty of its being absorbed, and to meet these indications we may employ catgut prepared in the following manner: Take ordinary commercial gut, which may be procured of various sizes. Place it in oil of juniper for two days to remove the oil of the gut; then wash it in 95 per cent. alcohol, and place it in the same fluid for preservation. Put it to soak in the bichloride solution of 1 : 1000 for ten to fifteen minutes before it is used in operations. Such gut will be absorbed in from five to ten days, according to its size. If it is necessary that it should remain longer before absorption takes place, it may be chromicized according to the method of Lister, which is as follows: Take 1 part by weight of gut and place it in a solution containing 1-200 part of chromic acid and 1 part of carbolic acid to 20 parts of water. In forty-eight hours the color of the solution changes from orange to a faint olive color. The gut should then be withdrawn, washed, and preserved in alcohol. It is treated with bichloride just before it is used, and will be absorbed, according to size, in from ten days to three weeks. Silk of various sizes, purified by boiling and by soaking in sublimate solution, is almost as certain to disappear by absorption, and is thought to be even more free from the risk of carrying infection.

The sponges which are used should be prepared in the following manner:

1st. Soak in—

℞.	Acid. hydrochlor.,	f ʒiv ;
	Aquæ destillat.,	Oiv,

for twenty-four hours.

2d. Wash thoroughly, and place in the following solution:

℞.	Potass. permang.,	ʒiij ;
	Aquæ destillat.,	Ovj,

squeezing them frequently.

3d. Remove, squeeze, and drop into—

℞.	Sodii hyposulph.,	ʒx ;
	Acid. hydrochlor.,	f ʒv ;
	Aquæ destillat. q. s. ad,	Ov.

M. et filtra.—Use while fresh.

Put your sponges in, and let them remain a few minutes until bleached. Remove immediately, wash thoroughly in distilled water; store them in dry jars with glass stoppers. If the hyposulphite solution does not bleach well, add more hydrochloric acid.

Various substitutes for sponges have been suggested, partly on account of the expense and partly of the alleged difficulty of accomplishing thorough sterilization. Balls or wads of sterilized cotton wrapped in sterilized gauze have been recommended as not open to the this objection, but the above method is very inexpensive and very efficacious, and sponges sufficiently good for all ordinary work can be bought at a cost not exceeding a fraction of a cent each. They should be thrown away at the completion of the operation.

As to the particular antiseptic to be employed there is still room for some difference of opinion.

The aim of the surgeon after every operative wound is, of course, to secure union by first intention. Any persistent irritation is a source of trouble in wounds, and the different antiseptics which have been employed have not been free from the charge of contributing to the occurrence of excessive inflammation by their own irritant action. The typical antiseptic must therefore be as nearly as possible devoid of irritating properties. It must be germicidal—that is, it must possess the power of destroying the micro-organisms. It must have an inhibitory power—that is, it must prevent the development of such organisms. It must be stable—that is, it must not disappear from the dressings after they are made or after they are applied to the wound either by solution in the discharges or by volatilization.

In the old Listerian method carbolic acid was the antiseptic employed, but this had the disadvantage of volatility as well as great slowness of action as a germicide. Corrosive sublimate, which succeeded it, was

stable and acted rapidly, but was exceedingly irritating, and, in addition, was precipitated by the albumen contained in the serum of the blood. This precipitate, it was discovered by Sir Joseph Lister, possessed powerful antiseptic properties, with much less power of producing irritation, and he therefore devised a form of antiseptic dressing called "the sero-sublimate gauze," which consisted of gauze charged with a solution of corrosive sublimate in the serum of the blood. This, however, was difficult to manufacture, and produced a harsh and non-absorbent material which was mechanically objectionable. It was succeeded, in his hands, by a combination of chloride of ammonium and bichloride of mercury, known as sal-alembroth, which, while much less irritating, was so exceedingly soluble in the blood-serum that whenever the discharges from the wounds were copious it was washed out of the dressings, leaving them without antiseptic property. For these reasons Lister in time discarded this material, and employed for a considerable period a gauze containing 3 or 4 per cent., by weight, of the biniodide of mercury. This was less soluble, non-volatile, powerfully antiseptic, but, again, extremely irritating, so that the least contact with the skin produced an intense erythema, even going on to vesication.

Lister was then led to look farther for the ideal antiseptic, and finally to employ the double or mixed cyanide of mercury and zinc, which he is now using. Its most evident advantages are—first, that it is non-volatile; next, that it is almost entirely unirritating; thirdly, that it is insoluble in water and only soluble in 3000 parts of blood-serum; and, finally, that, while it possesses but little germicidal value, its inhibiting power is so high that a 1 : 1200 solution is sufficient to keep animal fluids permanently free from putrefaction. This combination of qualities is possessed by no other of the antiseptics which have been mentioned, and its deficiency in germicidal power is easily remedied by including in the manufacture of the gauze dressings which are impregnated with this material a small percentage (1 : 4000) of sublimate—enough to be germicidal, but too weak to be markedly irritating.

The manufacture of the salt and of the gauze is described as follows: Cyanide of potassium, cyanide of mercury, and sulphate of zinc are mixed together in solution in quantities proportioned to their atomic weights, the cyanide of potassium and cyanide of mercury being dissolved together in 1½ ounces of water for every 100 grains of potassium cyanide, and added to the sulphate of zinc dissolved in three times that amount of water. The precipitate is collected on a strainer, and when well drained is washed with two successive portions of water equal in quantity to that used for the solution—viz. 6 ounces for every 100 grains of potassium cyanide—at least this amount of washing being essential in order to free the precipitate sufficiently from

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the highly irritating soluble salts which are associated with it in its formation. The precipitate having been thus washed and drained, but not dried, it is thoroughly diffused with pestle and mortar in distilled water (6 ounces for every 100 grains of potassium cyanide) containing in solution 1 part of hæmatoxylin for every 100 parts of the cyanide salt, the amount of which is known from the circumstance that the dry product of cyanide salt is almost exactly equal in weight to the potassium cyanide employed. Hæmatoxylin is readily soluble in a small quantity of hot water, and remains in solution when added to a large quantity of cold water. The cyanide salt, while it precipitates the hæmatoxylin, changes its color to a pale-bluish tint. This is advantageously enhanced by the addition of a little ammonia to the mixture, in the proportion of one atom of ammonia to each atom of hæmatoxylin: more than this proves prejudicial. The ammonia is added in a dilute form, and it is convenient to have the dilution such that one fluid-drachm of the ammoniacal liquid shall correspond to one grain of hæmatoxylin. The dye is further economized by allowing the ammoniated mixture to stand for three or four hours and stirring it occasionally, so that the ingredients may react thoroughly upon each other. If the mixture is filtered immediately, there is considerable loss of coloring matter. The dyed salt, having been drained and dried at a moderate heat, is levigated, and may then be kept for any length of time. When employed for charging a dressing it is diffused by means of pestle and mortar in solution of bichloride of mercury (1 : 4000) in sufficient abundance to drench the fabric thoroughly, for which 4 imperial pints to 100 grains of the salt will be found adequate. This will give a percentage of between two and three of the cyanide to the dry gauze. The gauze should always be used moist, and if it be prepared for immediate use the process of drying may be omitted, the gauze, after having been hung up for a while to drain, being further deprived of superfluous moisture by placing it in a folded sheet. It may afterward be conveniently kept moist by wrapping it in a piece of mackintosh cloth. When obtained dry from the manufacturer, it should be moistened again with the weak corrosive sublimate before it is used.

In the employment of this gauze we proceed as follows: Immediately over the wound we place a portion of the cyanide gauze, washed in a solution of carbolic acid to get rid of the bichloride of mercury in the dressing in contact with the wound. For this purpose 1 part of carbolic acid to 20 of water is safer than any weaker solution. A very pure acid should be used, because if impure it is not completely dissolved, and the undissolved particles are needlessly irritating to the surgeon's hands. When a dressing is changed this piece of gauze is applied over the wound before the surrounding parts are cleaned with

the carbolic solution. The carbolic acid soon flies off from the washed gauze, leaving nothing in it in contact with the wound but the unirritating cyanide.

By proceeding in this way it is not necessary to use "protective." The amount of unwashed gauze to be applied will depend upon the amount of discharge anticipated. In the early stage of a wound, where we expect much sero-sanguineous oozing, it is desirable to use a considerable mass, say an inch in thickness, and extending on all sides beyond the wound. Further, it is well, where free discharge may occur, to place over the dressing a piece of thin mackintosh (antiseptically washed), with the caoutchouc side next the dressing. This is for the purpose of preventing the discharge from coming directly through the dressing. It should not, of course, overlap the gauze, nor need it even extend to its edge. When the part operated on is placed on a splint, as after resection of the knee, the padding of the splint is lined with such a piece of mackintosh.

It is unnecessary to purify bandages or elastic bands that are placed outside of this dressing, but if a bandage is used in the interior of the dressing, as in bandaging a stump next the skin, it is purified sufficiently by soaking it thoroughly with a solution of corrosive sublimate 1 : 2000.

On the whole, I personally prefer this cyanide dressing to any I have yet employed, for the reasons given above.

It is necessary, however, to describe the ordinary bichloride dressing and the materials which compose it, as it is by far the most extensively used of any of the formal antiseptic dressings in vogue at the present time.

The dressings which are applied to the wound are, in the order of their application, as follows: Iodoform is dusted thoroughly over the wound and surrounding surfaces, and sometimes into the wound itself. While there is some difference of opinion in the profession as to the exact value of this agent as a germicide, and while it has apparently been shown that in the dry condition it exerts but a slight influence upon micro-organisms, yet it is unquestionable, in the light of clinical experience, that, moistened by the excess of liquid in the dressings or by the discharges from the wound, it is extremely valuable, having a special influence upon certain forms of inflammatory processes, notably the tubercular. Certainly, the microscopical evidence will have to be much stronger than any yet adduced before practical surgeons will be content to dispense with an article which has seemed to be of such value in the treatment of wounds. To render it absolutely unobjectionable, however, I employ only sterilized iodoform—*i. e.* iodoform which has been thoroughly washed in 1 : 1000 sublimate solution, and afterward with distilled water. If applied with a brush to a wound,

the brush should first be sterilized, and should not be used again. A powder-blower for iodoform should be used in a pure atmosphere only. We should not look for the action of iodoform at a distance[1]—an action throughout a wound when only a portion of it is in contact with the powder, nor in the depths of a wound when only the surface is covered with iodoformized gauze. We should not use iodoform during a primary operation in uninfected tissues, since we know that septic infection will not be counteracted by the simultaneous application of iodoform. But we should value iodoform for its action in preventing the subsequent infection of wounds, both during the change of dressings and in case of accidental exposure. Its favorable influence upon the granulations makes it of value in open wounds, and in wounds already septic it should be used as extensively as possible, endeavoring to bring the powder into contact with every part infected. We should not expect it to influence already existing septicæmia or pyæmia.

The greatest benefit will be derived from iodoform by its use in operations about the mouth, vagina, and rectum, where, owing to its property of destroying the ptomaïnes, it acts as a powerful deodorizer. For the same reason its use on putrid surfaces is to be recommended.

After dressing the wound with iodoform, to protect its edges from irritation by the antiseptic employed, a piece of "protective" is then applied along its entire length, leaving uncovered the extreme angles from which the catgut or drainage-tube issues. The protective consists of oiled silk coated with copal varnish and treated with 1 part powdered dextrin to 2 parts powdered starch and 16 parts 1 : 20 solution of carbolic acid. This is the formula for the old Listerian protective. The dextrin and powdered starch are used to give a surface which will permit a film of water to spread itself over it in a uniform manner. If the protective were simply varnished and then dipped in an antiseptic solution, the latter would gather in drops upon its surface and would not diffuse itself evenly. This is the most elegant material for the purpose with which I am familiar, but many surgeons employ ordinary waxed paper or oiled silk in its stead.

The gauze which constitutes the next portion of the dressing consists of ordinary cheese-cloth impregnated with one or the other of our three great antiseptics—corrosive sublimate, carbolic acid, or iodoform, the first and last being preferable, under the limitations above mentioned, on account of the volatile character of the carbolic acid. The following formulæ can be used in making these forms of antiseptic gauze: The cheese-cloth is rendered absorbent by boiling in water to which a small amount of soda has been added to remove its greasiness, and is then hung up to dry. After this it is soaked in a solution of 1 part of sublimate and 2 parts of common salt and 500 parts of water,

[1] *Annals of Surgery*, March, 1889.

and is then wrung out and dried in a clean room, after which it is kept in a moist condition in jars; the salt prevents the conversion of the sublimate into calomel. In making iodoform gauze take 3 drachms of iodoform and mix with 6 ounces of ordinary castile soapsuds; pour this emulsion over 3 parts by weight of absorbent gauze, and evenly distribute it through its meshes by rubbing. This makes a 10 per cent. gauze, the soap holding the iodoform in the meshes of the fabric; for 25 per cent. gauze the iodoform should be increased to 7 drachms.

In the majority of cases the sublimate gauze should be applied directly over the protective in a thickness of from eight to ten layers, wrung out just before applying from a 1 : 1000 sublimate solution. This wet dressing, which is undoubtedly actively antiseptic while in the moist condition, has two disadvantages—first, it interferes with evaporation of the wound secretions; and, second, it has a tendency to produce eczema.

The great objection to ordinary sublimate gauze as it is employed in most hospital wards is that, as kept in the usual way, it is not free from germs, and can only be depended upon in the recent moist state. Besides, as Schlange has shown, much of the antiseptic action of sublimate dressings is lost when they become soaked with blood or albuminous fluids. The first difficulty is overcome by keeping the dressings moist or using them in that condition; the second may likewise be removed by the addition of tartaric acid to the sublimate solutions, using for irrigation, for example, a solution of 1 part sublimate to 5 parts tartaric acid and 1000 parts distilled water, and for impregnating the gauze 5 parts sublimate, 20 parts tartaric acid, and 1000 parts distilled water. It has been shown that in this manner the precipitate of albuminate of mercury, which otherwise takes place, leaving the solution inert, may be prevented. Outside of the gauze should next be applied some antiseptic absorbent cotton, or cotton from which all grease has been removed by treatment with alkalies, and which has afterward been impregnated with corrosive sublimate. This can be bought from reliable manufacturers at low cost, and the formula for making it need not be described. These dressings are maintained in place by bandages made from strips of antiseptic gauze.

All instruments used should have been cleaned first with soap and water, then boiled, and finally soaked in the 1 : 20 carbolic solution for not less than fifteen to twenty minutes before the operation. The too common custom of simply dipping an instrument in an antiseptic solution and assuming that its purification has been complete is most objectionable. This is by no means the case, and although it occurs more rapidly when sublimate solutions are used, the effect of this upon the surface and edge of the instruments is so undesirable that it is far

better, whenever possible, to have the instrument soaked in the carbolic solution for the time above mentioned.

It should be remembered that if we have been entirely successful up to this point in excluding from the closed and covered wound all living organisms, our patient still has certain dangers to run. In many cases during the first twenty-four hours one of two occurrences will take place: Either the dressing will loosen, so that air can pass in freely under its edges, which often results from the subsidence of inflammatory swelling, or oozing of blood or serum will take place to such an extent as to penetrate the various layers of the dressing and show upon its surface. In either case a direct road to the wound is offered to such organisms as may find their way to the edge or the wet surface of the dressing. In the first case it will only be necessary to apply around the edge of the dressing a thin layer of sublimate cotton held in place by another and firmer antiseptic bandage. In the case of oozing, however, steps should be taken to protect the blood- or serum-soaked dressings from contact with the surrounding atmosphere or with substances not previously rendered aseptic. With the latter object in view I have all stumps after amputation placed upon pillows made of sublimate cotton, so that the first discharge which appears will be received by and will soak into the pillow, and I make similar arrangements for receiving the discharges from all operative wounds. When the dressing does become soaked, if it is but to a moderate extent, it should be reinforced with sublimate cotton, in the hope that it will then dry out and remain aseptic. If that drying-out process is not interfered with, and the dressings and wound have been aseptic throughout, there is soon attained by evaporation of the wound secretions a degree of concentration which is incompatible with the development of micro-organisms; and if then no opportunity be given the latter to effect an entrance beneath the dressings, they may be left in place for an indefinite length of time. Schlange has shown this experimentally, and believes that even when there is great soaking of the dressings and the superficial layers have to be changed, the deep layers, if they have begun to dry out, should be left undisturbed.

Whether pyogenic organisms effect their entrance through the dressings or beneath them during the interval between the change of dressings, they most commonly, as Cheyne has shown, spread inward by growing in the discharge which is lying between the dressings and the skin and in the superficial layers of the epidermis, more especially in the latter if, as the result of the irritation of the antiseptic employed, there is hypertrophy of the epithelium. A large number of dead epithelial cells are then present, which, being soaked with the discharge, form a good nidus for the development of bacteria, unless indeed enough of the antiseptic has been communicated to the discharge

and to the epithelium from the dressing to render it an unsuitable soil for the growth of organisms. If this is not the case, the organisms will go on growing in the substance of this dead epithelium, protected by the superficial layers from the action of the dressing, and thus may, if the latter is left on for a long time, ultimately reach the wound. Mr. Cheyne has been able to demonstrate the progressive development of organisms beneath the dressings from the margin toward the wound, the extent to which they had spread varying with the length of time that the dressing had been applied. He adds very properly that if these views as to the mode of entrance of bacteria into wounds are correct, it follows that it is very important, when the dressing is changed, to wash and throughly disinfect the skin around the wound as far as the dressing extends, and beyond it, with an antiseptic lotion, care being of course taken by covering up the wound not to infect it while so doing. If this be done, then at each change of dressing the field of battle is transferred from the neighborhood of the wound to the margin of the dressing, and in accordance with the size of the dressing this battlefield will be at a greater or less distance from the wound. At each change of dressing the same precautions are to be observed in regard to the hands and instruments as during the operation.

In operating upon wounds already infected or in regions where subsequent infection is extremely likely—as, for example, in operations in the interior of the mouth, the anus, etc.—chloride of zinc in the strength of from 40 to 20 grains to the ounce of water is a most valuable application. It produces a superficial albuminous coagulum which protects the underlying parts from infection during the first thirty-six or forty-eight hours, after which time healthy granulations springing up beneath will usually offer an effectual barrier to the entrance of organisms. The same drug when injected into suppurating sinuses or used as a wash for old ulcers has a similar beneficial effect.

If a wound becomes infected during or after an operation, as shown by persistent elevation of temperature, pain, swelling, tension, and redness of the edges, it will be proper to remove either all stitches or every alternate stitch to provide thoroughly for drainage, to irrigate frequently, to change dressings at least once daily or oftener if profuse suppuration has occurred, and particularly if the discharges be offensive. No hesitation should be felt under these circumstances in converting the wound into an open one by gently separating its edges, and drainage should be carried into every crevice or pocket beneath the flaps. Abscesses should be opened, fragments of necrosed tissue should be removed with forceps and scissors, moist dressings in considerable thickness should be applied.

It should always be remembered that a large proportion of *acci-*

dental wounds are already aseptic. This applies especially to gunshot wounds and to compound fractures made by blunt forces or by the sharp ends of the bones themselves. In all cases it is extremely important not to add to the patient's risk by a hasty exploration with a dirty finger or by an instrument just removed from a pocket-case. It is far better in all such cases, after the hæmorrhage has been arrested by proximal compression of the main vessel, to cover the wound with some dressing soaked in sublimate lotion of 1 : 1000, and then have the patient conveyed to a place suitable for proper operative work.

A number of surgeons have aimed with greater or less success at obtaining union under one dressing. The essentials for this are—1, that there should have been faultless asepsis; 2, the absolute arrest of hæmorrhage; 3, the use of ligature and suture material which is thoroughly absorbent; 4, the avoidance of the formation of cavities within the wound, which is brought together with scrupulous exactness by the use of sutures *en étage* and by a careful compression of the flaps through the dressing and bandages; 5, the avoidance of drainage-tubes; and 6, the employment of an absorbent dressing impregnated with a reliable and stable antiseptic. In some cases of operations upon bones and others which leave cavities that cannot be obliterated, Schede's method, which aims at union under a moist blood-clot, may be adopted. In other cases, where exact hæmostasis is important or in operations through infected or tuberculous tissues, the so-called tamponade and secondary suture may be employed. The wound is filled with iodoform gauze, and the sutures are either not applied at all for from three to eight days, or, if inserted at the time of operation, are not tightened until after that lapse of time.

Schlange has described[1] a series of experiments which led him to the conclusion—first, that ordinary dressings thought to be aseptic are not so, but contain various species of germs; and next, that the antiseptic action of many if not all of these dressings, believed to result from the liberation in the wound secretions of the material with which they are impregnated, is no less unreliable. The majority of his experiments were made with sublimate dressings, and appeared to show that when freely mixed with blood or albuminous fluids much of the antiseptic action was lost. There are, of course, certain methods by which dressing materials can be rendered absolutely free from bacteria: soaking in boiling water or in a sufficiently strong sublimate solution will effect this at once, and if we apply over a wound materials taken directly from boiling water or from the sublimate solution, and still wet, we may be sure we have put on a truly "aseptic" dressing. The chief disadvantages of the wet dressings are the interference with the evaporation of the wound secretions and the tendency to produce

[1] *Archiv für klinische Chirurgie*, vol. xxxvi., 1888.

eczema. For these reasons, in Von Bergmann's clinic impregnation of the gauze with sublimate has been discarded, and dependence is placed entirely upon gauze sterilized by steam. The raw material, cut of proper sizes and lengths, is put in a wire basket, exposed to superheated steam in an oven for an hour, then removed, and, after drying for a minute, the basket, with its untouched contents, is put into an iron cylinder, from which the gauze is withdrawn as required. This is said to secure, with the minimum of handling, a germ-free material under which wounds sometimes do admirably. The results which I have myself seen in this and other European clinics where asepsis is aimed at have not been such as to encourage me to attempt its introduction in my general work, and especially have I been disinclined to do so in my hospital and clinical work.

A brief résumé of the wound treatment adopted by some eminent continental surgeons will serve to complete this view of the subject.[1]

Von Bergmann requires the patient to be thoroughly cleansed with soap in a warm bath, after which he is brought immediately to the operating-table, shaved, washed with alcohol or with ether, if necessary; and, finally, the field of operation is washed with bichloride of mercury 1 : 500, and surrounded with towels wet in the same solution. The operating-table is covered with a sterilized cloth. Operators and assistants cleanse their hands according to the method pursued in regard to the operative field. Everything which can come in contact with the patient—clothing, scrubbing-brush, etc.—is previously sterilized by superheated steam, except the sponges, which are washed in boiled water and soaked in bichloride solution. The instruments are sterilized by carbolic lotion. For ligatures and buried sutures sublimate catgut is used; for superficial sutures sterilized silk is employed.

Since the air of the ordinary clinic-room is rich in pathogenic organisms, the wound should be carefully protected during operation by sublimate compresses. Absolute hæmostasis is insisted upon, even slight oozing in connective tissue or bone-cavities being checked. The wound is then irrigated with 1 : 2000 sublimate solution, dried by means of sterile gauze compresses, drained, closed, and dressed with sterile gauze containing antiseptic absorbent cotton and a moss pillow. These dressings are sterilized by means of heat. If the wound is already infected, it should be opened freely, cleansed, drained and counter-drained, packed loosely with iodoform gauze, and dressed with sterilized gauze and the moss pillow. The superficial dressing is changed, but the packing is not disturbed unless it becomes wet and dripping. In that case it is removed and a drainage-tube substituted for it.

After operations which leave the surgeon not quite sure as to the

[1] *Centralblatt für Chirurg.*, 1889.

absence of infective matter in the tissues, or in case the bleeding has not been thoroughly checked, or where the wound is in a region difficult to keep germ-free, Von Bergmann commends primary iodoform gauze tamponade with secondary suture.

Finally, after resections and arthrectomies performed for the cure of tubercular arthritis, the wound should be treated with 10 per cent. iodoform ether, and tamponed with iodoform gauze; the latter to be removed in two days and the wound sutured without providing for drainage.

In contrast to Von Bergmann's treatment, Mikulicz commends, in many cases, Schede's method of obtaining healing (moist blood-clot). The ordinary chemical antiseptics are used. Sponges are discarded for wads of sublimate cotton wrapped in mull and kept in sublimate lotion. During the operation the wound is washed out with sublimate solution every five minutes. All bleeding vessels are tied, the wound finally thoroughly irrigated, first with 5 per cent. carbolic solution, finally with the bichloride-of-mercury lotion, closed by relaxation sutures of silk or silver and a continuous catgut suture, and dressed with protective or gutta-percha tissue, 10 per cent. iodoform gauze wrung out in 5 per cent. carbolic lotion, and a moss pillow. In two places a little space is allowed between the sutures, so that any excess of blood can escape. If there is a cavity left at the operation which cannot be closed by approximation of the wound surfaces, the space for the escape of blood must be left at the highest portion of the superficial incision. The bandage is usually not changed till the wound is entirely healed. After operation upon tubercular inflammations Mikulicz recommends iodoform gauze tamponade and secondary suture. Of the 160 major cases treated by this method, Mikulicz has lost only 1. This patient died of consumption sixteen days after operation. In only three cases did pain and high temperature force him prematurely to change the dressing.

Schmid completely closes his wounds immediately and discards drainage. Should symptoms denoting tension or suppuration appear, he removes the dressing, takes out a stitch, and opens the wound somewhat. The site of operation is covered for twelve hours with moist sublimate compresses, and is finally washed with ether and sublimate solution. In every pause of the operation the wound is covered with sublimate sponges. There is no irrigation, and the minimum of sponging. Most careful attention is given to checking the bleeding, after which the wound is flushed with bichloride solution, dried, dusted lightly with iodoform, and approximated throughout its whole extent. A compression sponge is now applied, iodoform mull, and a moss pillow. The dressing is completed by a pressure bandage very firmly applied, which can be loosened if painful in twenty-four hours. In

wounds where pressure is not necessary, salicylated collodion painted over the skin sutures will prove a sufficient dressing. For infected wounds Schmid advises free opening, drainage by means of iodoform gauze, and antiseptic poultices.

Landerer [1] believes that now that the great problems of antisepsis have been solved it remains to us chiefly to improve in smaller matters our treatment of wounds, and to endeavor not only to cure all patients, but to do so *tuto, cito et jucunde.* Influenced by the fear of carbolic, iodoform, and sublimate poisoning in antisepsis, and by the difficulties of procuring sterilized fluids, etc. in asepsis, he has for a long time operated without bringing a drop of fluid of any kind in contact with the wound. The instruments are boiled and kept in a weak carbolic solution. The hands and the field of operation are disinfected by a modification of Furbringer's method. As the wound is made it is dried with pieces of sublimate gauze and filled with wads of the same material. The larger vessels are tied. Angles and pockets of the wound are united by buried stitches. The wound is entirely closed, no provision for drainage and no opening for that purpose being left. The dressings are applied with moderate pressure. The results of the method, according to his experience in 90 major operations of all sorts, are—1, all wetting and cooling of the patient are avoided; 2, the loss of blood is reduced to the minimum; 3, there is little or no danger of intoxication from absorption of the antiseptics; 4, the operation is shortened, as there is so much less time spent in arresting hæmorrhage; 5, healing is quicker and safer; 6, the antiseptic details are easier and more manageable; 7, the hands of the operator are not affected by contact with powerful antiseptics.

Antisepsis as applied to special regions may, with one or two exceptions, be dismissed with a very few words. In the operations upon the *brain* and *spine* experience has shown that no marked variation from the ordinary rules is necessary. The nerves exposed in excision of tumors, amputations, etc. are not peculiarly susceptible to irritation from antiseptic reagents, and neither *a priori* reasoning nor experience leads to the belief that the cerebral or the spinal centres require any different management. Antisepsis in ophthalmic surgery is of course influenced by the delicacy and susceptibility of the conjunctiva, and milder solutions require to be used.

In *abdominal* work the extraordinary power of self-protection possessed by the peritoneum renders asepsis peculiarly applicable, microorganisms in moderate quantity and unassociated with excess of fluid, blood-clot, or other material specially adapted for their growth, being rapidly disposed of by the unaided forces of nature.

Operative wounds about the *mouth* and *anus* are kept as nearly

[1] *Archiv für klinische Chirurgie,* vol. xxxix., 1889.

aseptic as possible by the free use of chloride of zinc, already alluded to, or by the employment of iodoform, aristol, and their congeners in powder or ointment.

The surgery of *joints* presents, in some respects, a special field. Hagar strongly advocates[1] the early use of antiseptic injection in a variety of cases of arthritis. He has used various liquids, but employs 1 : 20 carbolic-acid solution or 1 : 1000 sublimate solution, according to the character of the inflammation. He believes that a portion of the good effects realized from the use of the former fluid is due to its astringent property, and cites the practice of Dr. Schede, who has used it as an intra-articular injection in cases of habitual luxation of the shoulder-joint, and with excellent effect. He has himself cured a case of the well-known troublesome relaxation of the temporo-maxillary joint by a series of carbolic injections into the articulation, inserting the injecting needle between the condyle and the zygoma while the mouth was widely opened.

Of 100 cases of hydrops articuli of the knee, a cure resulted in all but 1, who died of pulmonary tuberculosis a few weeks afterward. In only 4 instances was it necessary to repeat the injection and washing of the joint, although in nearly 50 per cent. of the cases the disease had existed for from one to ten years.

Hagar dwells upon the simplicity and safety of his method of treatment, which, even in those cases that might have been curable by other means, shortens the time required and immediately relieves the joint of effusion which often persists for years. In other cases incision and drainage would have been thought justifiable, but puncture and washing out answered the same purpose, with much less difficulty and danger.

The operation is performed as follows: The region is cleaned and made absolutely aseptic: a trocar is introduced into the joint, together with a canula fitting the syringe to be employed. After it is evident that it has entered the cavity the trocar is withdrawn, the fluid evacuated, and the antiseptic solution injected forcibly and repeatedly until it issues clear and free from all mixture with blood or pus. It should be thoroughly diffused, so as to come into contact with the inner surface of the capsule at every point. Strong flexion and extension, made while the trocar opening is closed with the fingers and the joint half filled with fluid, aid in bringing this about. Some caution is necessary in performing this part of the operation, as it has happened to as distinguished a surgeon as Billroth to lose a patient by carbolic-acid poisoning from penetration of the intermuscular spaces of the thigh by the liquid forced out of the capsule by too vigorous movement.

The little puncture is covered with an antiseptic dressing, and the

[1] *Deutsche Zeitschrift für Chirurgie*, vol. xxvii., 1887.

joint immobilized for eight or ten days, after which, at a time depending on the severity of the case, passive motion is begun.

In urinary and genito-urinary diseases special difficulties and problems are met with. The urinary diseases, which are generally admitted to be septic in origin, may be septicæmic or pyæmic whenever there has been an accident or operation which has produced a solution of continuity, such as a rupture of the urethra, the division or divulsion of a stricture, lithotomy or cystotomy, or even a difficult catheterization or a litholapaxy in which abrasion of the mucous membrane has occurred. In all of these cases the principles, both in cure and prevention, are the same as those which apply to ordinary wounds. A far more common form of sepsis is that following the fermentation in the urine set up by the introduction of micro-organisms upon dirty instruments. This results in cystitis and often in pyelo-nephritis, and is a common cause of death after the beginning of catheterization in cases of atony of the bladder or hypertrophy of the prostate, associated with a considerable quantity of "residual urine." The disinfecting of the instruments employed in urinary cases is therefore in the highest degree important. All instruments after using should first be scrubbed with soap and cold water, and then boiled from twenty to thirty minutes. Rubber instruments should be soaked for a long time in an antiseptic solution, so that the boiling may be dispensed with. The 1 : 20 carbolic solution is possibly the best for this purpose.

The lubricant should always be either aseptic or antiseptic. An ointment containing 1 drachm of boric acid to the ounce of carbolated vaseline or cosmoline is extremely useful for this purpose. Freshly-prepared carbolized olive oil (1 part carbolic acid to 30 or 40 of oil) is a moderately good lubricant.

When the bladder has been already infected, irrigation with very dilute corrosive sublimate (from 1 in 50,000 to 1 in 20,000); permanganate of potash (1–10 to 3–10 per cent. solution), boric acid (10 to 30 grains to the ounce), hydrogen peroxide (from 1 in 10 to 1 in 2) are among the best antiseptics to be used for this purpose. Wherever thorough drainage is possible, it, of course, is most strongly indicated, and as an application to the wounds of cystotomy, perineal section, etc. no drug is so valuable as iodoform. The internal administration of boric acid and salol is of great use, and to this may be added eucalyptus and benzoic acid as almost equally valuable.

Urethritis, by reason of its great frequency and its serious complications and sequelæ, is a genito-urinary disease of much importance from this standpoint. The application of the principle of antisepsis to the treatment of urethritis may be made for one of two reasons and in one of two ways. The drugs employed may be given on account of their supposed action upon either the microbes of suppuration or upon the

alleged specific microbe of gonorrhœa—the gonococcus of Neisser. They may be used locally or may be administered by the mouth, although, even when given in that way, their action is largely a local one.

As to the *reason* for their employment, in the light of modern pathology it is not necessary to believe in an invariable and essential relation between the gonococcus and gonorrhœa to see a clear indication for the use of germicidal agents. The successful treatment of suppuration anywhere demands the employment of some such agent, though it must be admitted that when the pus is furnished by a mucous surface the difficulties of treatment—*i. e.* of successful antisepsis—are greater than under most other circumstances; and it must likewise be admitted that those difficulties are much increased when the suppurative process is established in a canal like the male urethra, the anatomical peculiarities of which favor so markedly microbic growth or multiplication.

Its length and narrowness; the approximation of its walls during the intervals of urination; the delicate and actively absorbent mucous membrane which lines it; the passage through it at short intervals of an animal fluid of more or less irritant properties and prone to decomposition; the opportunities offered by the various follicles and lacunæ and by the curves and dilatations of the normal canal for the retention of any foreign matter,—all render the problem of antisepsis a complicated and a difficult one.

Unfortunately, the results of culture experiments and of the influence of parasiticides upon gonococci external to the body do not afford satisfactory evidence as to the effect of the same agents when applied to the same germs imbedded in the depths of an inflamed urethral mucous membrane. Bumm's investigations appear to show that at first they multiply by preference in the papillary layer, and find their way to the surface only during the latter part of the purulent and during the subsiding (or muco-purulent) stage; and Finger uses this as a theoretical argument against the early administration of either astringents or antiseptics. Enough is known, however, to enable us to state with certainty that the agents which are effectual against the microbes of suppuration are not equally destructive of the gonococci, several competent observers having noted the fact that antiseptic solutions, when applied to gonorrhœal secretions outside of the body, have seemed to exert but little effect upon the gonococcus even when strong enough to destroy pus-cells almost immediately. Clinically, we may now assume that, in the majority of cases of acute urethritis, gonococci, the microbes of suppuration, and other bacteria will be found intermingled, and that successful treatment by germicidal agents will involve the destruction of all the different varieties present.

I have found that to overcome the special difficulties of the case a combination of several antiseptics was desirable, and have recently employed with success as an injection a mixture containing sublimate, boric acid, and sulphocarbolate of zinc in peroxide of hydrogen. In conjunction with this the internal administration of salol and boric acid, with or without the essential oils or oleoresins of cubebs and copaiba, acts most efficiently by rendering the urine aseptic or even antiseptic.

Burns and Scalds.—A most efficient and almost painless method of managing burns and scalds is that practised by Mosetig-Moorhof. The vesicles having been opened and excised, the entire burned surface is smoothly covered with dry compresses of 20 per cent. iodoform gauze, over which gutta-percha tissue is placed. The whole is then surrounded by a thick layer of sterilized absorbent cotton between layers of corrosive gauze, which is secured by a roller with a moderate degree of pressure. Such a dressing rapidly relieves pain, prevents contact of air and infection by septic pus, and by its infrequency keeps the part at rest. It should be allowed to remain from seven to fourteen days. In burns of the second degree one dressing suffices. In the worst burns there is relatively little suppuration and the eschars thrown off are aseptic.

For burns of the face iodoform ointment (1 part iodoform, vaseline 20 parts) is used, and covered with a gutta-percha tissue mask. The ointment should be renewed daily.

NUTRITION AND FOODS, INCLUDING THE TREATMENT OF OBESITY AND LEANNESS.

By I. BURNEY YEO, M. D., F. R. C. P.

Food is needed to supply the body with the substances required for its growth and repair, and for the development of those modes of energy which are termed its functions. A perfect food for any living organism must comprise all the elements needed for the maintenance of its structure and the support of its functions. It is also an essential condition that these elements be supplied in such forms or in such states that the organs of the body can digest and assimilate them.

The various organic and inorganic compounds which enter into the composition of the human body may all be resolved into the following twelve elements: carbon, hydrogen, oxygen, nitrogen (these four in far greater proportions than the others), sulphur, phosphorus, chlorine, iodine, potassium, calcium, magnesium, and iron. A few other elements (such as fluorine, silicon, manganese, etc.) have been discovered in the human body, but it is doubtful if they are invariably or necessarily present.

All these twelve elements must be represented in the food of man, and they must be, for the most part, combined in the form of organic products capable of being appropriated by his digestive organs.

If we examine the chemical composition of those organic compounds prepared by the vegetable world, and which serve as food for animals, we find they consist chiefly of the following elements: carbon, hydrogen, oxygen, nitrogen, sulphur, and phosphorus.

Of these elements nitrogen is the most important, as it is *the* essential element of all *living* things: vital phenomena, the activity and change characteristic of all *living* things, are found only where this element is present.

Alimentary Principles.[1]—As the result of the chemical analysis and investigation of the various substances commonly used as foods, it has been found possible and convenient to take certain *alimentary principles* found in them as a basis for the classification of foods into four great divisions, the members of each division possessing a remarkable

[1] For the arguments and facts on which the following conclusions are based the reader is referred to the author's work on *Food in Health and Disease.*

similarity in composition and differing greatly in physical and chemical characters from the members of the other groups.

These different groups also appear to serve more or less different purposes in nutrition, although to some extent the members of one group may replace those of another. A combination of all four classes appears to be necessary for the maintenance of the animal body in perfect health.

These groups of alimentary principles are here exhibited in a tabular form:

Alimentary Principles.

1. *Albuminates*—Nitrogenous substances, having the same or nearly the same chemical composition as Albumin. *Examples*: Albumin, Fibrin, Syntonin, Myosin, Globulin, Casein, from the *animal;* Glutin and Legumin, from the *vegetable* kingdom.

   (*a*) *Subordinate* nitrogenous substances referred to this class, and known as—

   Gelatigenous substances { Gelatin, Chondrin.

2. *Fats* or *Hydrocarbons*, containing Carbon, Hydrogen, and Oxygen—the proportion of oxygen being insufficient to convert all the hydrogen into water. *Examples*: Olein, Stearin, Margarin (Butter is a familiar one).

3. *Carbohydrates* contain Carbon, Hydrogen, and Oxygen, the two latter elements in the proportions to form water. *Examples*: Starch, Dextrin, Cane-sugar, Grape-sugar, and Lactose or Milk-sugar.

   (*a*) The *Vegetable Acids*, Oxalic, Tartaric, Citric, Malic, Acetic, and Lactic, are by some authors referred to this class.

4. *Mineral.*

Salts.—Sodium and Potassium Chlorides, Calcium and Magnesium, Phosphates, Iron, etc. etc.

Water.

In addition, however, to these four groups may be mentioned the various substances termed *food-accessories*, comprising the several condiments which give flavor to food or stimulate the digestive secretions, and the well-known "stimulants," tea, coffee, cocoa, alcohol, etc.

The uses and purposes of these different classes of alimentary substances may now be briefly stated:

(1) The functions of the class of albuminates is no doubt threefold:

(*a*) They contribute to the formation and repair of the tissues and fluids of the body, and in an especial manner to that of the nitrogenous tissues.

(*b*) They regulate the absorption and utilization of oxygen, and so play a very important part in the chemistry of nutrition.

(*c*) Under special conditions they may also contribute to the formation of fat, and to the development of muscular and nervous energy, and to the production of heat. They are capable of splitting up in the organism into a nitrogenous and a non-nitrogenous part, and from the latter fat may be formed and deposited in the tissues or consumed in the production of force.

With regard to the utility of the *gelatigenous* substances in nutrition, it has been determined that gelatin is useful as an "albumin-sparing" food, and that alimentary substances containing it tend to prevent the destruction of albuminates and fats. It is especially appropriate to those febrile states in which the stability of the "organic albumin" is threatened, and at the same time the capacity of assimilating albuminous food is greatly diminished.

(2) As to the uses of the *fats* and *hydrocarbons* in nutrition, one of the great purposes served by fat in the food is to diminish albuminous metabolism, and it is therefore regarded as an "albumin-sparing" food. "If flesh alone be given, large quantities are required in order that nutrition and waste may balance one another, but if fat be added the demand for flesh is less."—*Bauer.*

But the fats also have an important relation in the body to the production of force and heat, to body-work and body-temperature. While, unlike the albuminates, the metabolism of hydrocarbons is independent of the amount taken in as food, it is notably affected by bodily exercise, which produces little effect on nitrogenous metabolism. The fats, therefore, undoubtedly minister to force-production, and undergo destruction and oxidation in the process; so that the amount of carbonic acid given off during exercise is much greater than during rest.

It would appear that albuminates and fats are, to a certain extent, opposed to one another in their action on the organism, as the former increase waste and promote oxidation, while the latter have the effect of diminishing these changes, and this they do probably by affecting the metabolic activity of the cells of the tissues themselves.

A proper use of fat economizes the albuminous elements of food and checks the waste of the albuminous tissues. Fat enters into all the tissues. By its decomposition and oxidation it yields muscular force and heat, and it is therefore largely consumed in muscular exercise. By its capacity of being stored up in the body as adipose tissue it provides a reserve store of force-producing and heat-generating material which can be utilized as required.

(3) The *carbohydrates*, like the fats, check albuminous waste. They are ultimately resolved by combustion within the body, like the hydrocarbons, into carbonic acid and water, and so, like the fats, are capable of yielding heat and mechanical work. Unlike the fats and the albuminates, however, they do not appear to enter into the structure of the tissues, although they are found in some of the fluids and organs of the body.

All the carbohydrates are converted into glucose, or grape-sugar, before they are absorbed, and in this form they are much more readily metabolized than the fats or albuminates.

It is believed by many—and the weight of evidence is in favor of the

conclusion—that carbohydrates can be converted into fat within the organism. It is certain that they promote, either directly or indirectly, the separation of fat within the body, and by their capacity for rapid metabolism contribute largely to the production of heat and mechanical work, and, also, that their use greatly favors an increase in the constituents of the body, and especially of the albumin and fat. If we desire (according to Bauer) to increase the albumin without adding greatly to the store of fat, we should give a liberal allowance of albuminates with relatively small quantities of carbohydrates. But if we desire a substantial addition to the fat, the food should contain less albumin and more carbohydrates, with a fair proportion of fats.

(4) *Water and mineral substances* are of great importance, and are as essential to nutrition as the albuminates. There is no tissue that does not contain lime, chiefly in the form of phosphate, and it would seem that cell-growth cannot go on without it; indeed, calcium phosphate is the most abundant salt in the body, seeing that it forms more than one-half our bones. Calcium carbonate occurs in association with this phosphate, but relatively in much smaller quantity. Sodium chloride is also a very important salt which likewise occurs in all the tissues and fluids of the body. It plays a very important *rôle* in promoting the diffusion of fluids through membranes, and its presence is necessary for maintaining the globulins in solution. It is absolutely necessary to existence, and its *entire* withdrawal from food would be speedily fatal. The phosphates of sodium and potassium are also important salts. The alkaline reactions of the blood-plasma and some of the other fluids is due partly to these alkaline phosphates. Iron is an essential constituent of hæmoglobin, and therefore of the red blood-corpuscles; it is found, also, in striped muscle and in other tissues in minute quantity. These and other mineral substances are introduced into the body as constituent parts of the various ordinary articles of human food, animal and vegetable, with the exception of sodium chloride, which is usually added to various articles of food in greater or less amount, although they may themselves contain it.

Water enters into the composition, in greater or less proportion, of most solid and all fluid foods, and it is the essential basis of all beverages. It forms 58.5 per cent. of the human body, from which it is continually passing off by the kidneys, bowels, skin, and lungs. Water is essentially requisite in the process of digestion and absorption as a solvent for food-substances, and it is also required for the solution of the various materials which have to be removed from the body in the excretions, especially in the urine. Indeed, there is no vital action possible without water. The amount of water needed by the body depends on various circumstances, especially on bodily temperature and bodily labor. The greater the functional activity of the bodily organs,

the greater the need for water. The temperature and humidity of the surrounding air also exercise an influence in this direction, as well as the nature and amount of solid food.

It has now been seen that each of these four classes of alimentary substances has a special value in nutrition, and although the members of one group may be competent to serve, to a certain extent, the purposes of those of another, yet in order to accomplish the best results a combination of all of them is required. An adequate diet must contain a mixture of several articles of food, in which all these classes are represented in due proportion.

Food-Stuffs.—Man derives his supplies of food from both the animal and vegetable kingdoms. *Animal* foods have certain decided advantages. In the first place, they contain the same chemical elements as the bodies they are destined to feed. They are very rich in albuminous or nitrogenous substances, combined with a certain amount of fat; they are more easily and completely digested and assimilated than vegetable foods; they are easily cooked, and develop agreeable flavors in the process; and they contain important salts (chiefly salts of potassium) and some iron.

Animal foods are therefore exceedingly well adapted to the growth and maintenance of the organic structure of the body; their disadvantage is the absence of starch, so that they are not so well adapted as non-nitrogenous substances for the production of force. When, however, there is a mixture of a considerable proportion of fat with the muscle-tissue, this disadvantage is greatly lessened.

Pavy gives the following as the composition of *lean* and *fat* beef:

	Lean Beef.	Fat Beef.
Nitrogenous matter	19.3	14.8
Fat	3.6	29.4
Salines	5.1	4.4
Water	82.0	51.0

Man chiefly selects vegetable-feeding animals for his food, such as the ox, sheep, pig, deer; also poultry, game, and wild-fowl, and next, all kinds of fish. The different kinds of fish vary greatly in nutritive value, in edible quality, and in digestibility. The relative proportion of fat which they contain is especially subject to variation, and the presence of this determines to a great extent their flavor and their facility of digestion. The lighter varieties, as the sole and whiting, contain least fat and are of more delicate flavor and easy of digestion. Many contain a large proportion of water.

The following table gives the composition of some of the more important species:

	Water.	Albuminates.	Fat.
Salmon	74.36	15.01	6.42
Eel	57.42	12.82	28.37
Herring (fresh)	80.71	10.11	7.11
Sole	86.14	11.94	0.25

One of the most important of animal foods is *milk*. Not only does it form the exclusive food for a time of the young of all the Mammalia, but it is also capable of being advantageously employed as the chief food for adults under various circumstances.

In milk we find all the alimentary substances necessary for health combined in proportions well adapted for the period during which growth is active; hence it is termed a *complete* food, but when applied to the feeding of adults the proportions of albuminates and fat are in excess as compared with the amount of sugar.

The percentage composition of good cow's milk is thus given by Parkes:

	Specific gravity, 1029 and over.
Water	86.8
Albuminates	4.0
Fats	3.7
Carbohydrate (lactose)	4.8
Salts	0.7

Milk is not a food well suited for the sole nourishment of adults; it should be mixed with other foods, especially carbohydrates, for if an adult requires daily 23 ounces of water-free food, it would take 9 pints of milk of a specific gravity of 1030 to supply this; but such a quantity of milk would give a considerable excess of albuminates and fat, and a very great excess of water; and although this excessive proportion of water and fat is essential for the rapid growth and due alimentation of the young, it would be a wasteful food for an adult.

The following table, from Dujardin-Beaumetz, compares the composition of human milk with that of the ass, the cow, and the goat:

	Woman.	Ass.	Cow.	Goat.
Specific gravity	1033.5	1032.1	1033.4	1033.85
Average Composition per litre, 1000 grammes.				
Water	900.10	914.00	910.08	869.52
Casein	10.52	12.30	28.12	44.27
Butter	43.43	30.10	34.00	60.68
Lactose	76.14	69.30	52.16	48.56
Salts	2.14	4.50	6.00	9.10

Human milk and ass's milk are richer in sugar than cow's or goat's milk, human milk being especially rich in lactose. Human milk is

also rich in butter, considerably more so than the milk of the cow or the ass, but not so rich in this ingredient as the goat's. Of the four milks, goat's milk is the richest in solids, and contains the largest proportions of nitrogenous and fatty constituents, as well as of salts; but it is comparatively poor in sugar. It also contains a peculiar-smelling acid—hircin or hircic acid. It is the most highly nutritious of these milks, but it is the least digestible.

Ass's milk, on the contrary, contains the smallest amount of solids, but is rich in sugar, although not quite so much so as human milk. It is poor in casein and in fat, resembling human milk in all but the latter particular. Ass's milk is therefore light, sweet, and easy of digestion, and is a most useful food for persons whose stomachs are too delicate to digest cow's milk easily. It is said to give rise occasionally to diarrhœa.

Eggs.—Eggs form another *complete* food. They contain all the elements of the blood, and the organism of the young chick is developed from them. But when regarded in the light of a complete food, the shell must be taken into account, for it is from the shell that certain essential constituents of the organism of the chick is obtained. In the process of incubation the earthy salts in the shell are dissolved by phosphoric acid, which is developed by the oxidation of phosphorus, and they are thus in a condition to be absorbed. Eggs therefore provide us with a highly nutritious food in a concentrated form.

The *vegetable kingdom* affords many varieties of food of great value to mankind. Like those derived from the animal world, they contain both albumin and fat, but, as a rule, vegetable foods occur chiefly as carbohydrates; the non-nitrogenous constituents are greatly in excess of the nitrogenous ones, and, save in the case of certain fruits and seeds, they contain but little fat.

The remarkable difference in these respects between animal and vegetable food is well shown in the following table from Hofmann:

	Nitrogenous constituents.	Fat.	Carbo-hydrates.	Salts.
Fat beef	51.4	45.6	—	3.0
Lean "	89.4	5.5	—	5.1
Pea flour	27.3	0.8	68.9	3.0
Wheat	16.6	0.9	81.9	0.6
Rice	7.7	0.4	91.2	0.7

Vegetable foods differ further from animal food in being less digestible and less capable of complete assimilation by the digestive organs of animals.

The most important vegetable foods are derived from those plants which produce *farinaceous* seeds—*i. e.* seeds yielding *meal* or *flour*.

The seeds of the *Cerealia*, one of the *grass* tribe, and of the *Leguminosæ* or *pulse* tribe, are of the greatest value and usefulness in this respect.

To the former belong those well-known "grains," wheat, barley, oats, rye, maize, rice, etc.; and the latter include those familiar articles of food, peas, beans, and lentils.

The following table (extracted from one by Bauer) exhibits the relative average composition of the more important cereal grains:

	Nitrogenous substances.	Fat.	Starch, sugar, gum, etc.	Cellulose.	Ash.	Water.
Wheat	12.42	1.70	67.89	2.66	1.79	13.56
Rye	11.43	1.71	67.83	2.01	1.77	15.26
Barley	11.16	2.12	65.51	4.80	2.63	13.78
Oats	11.73	6.04	55.43	10.83	3.05	12.72
Maize	10.05	4.76	66.78	2.84	.69	13.88
Rice	7.81	0.69	76.40	0.78	.09	13.23

Oats, it will be seen, are especially rich in fatty and mineral substances, and also in indigestible cellulose. Maize also is relatively rich in fat, but slightly deficient in salts. Barley contains more fat, more indigestible cellulose, and more salts than wheat, but less nitrogenous substances and less digestible carbohydrates. Rice is seen to be rich in starch, but defective in nitrogenous and, indeed, in all the other solid constituents.

The various *green*, fresh, and succulent vegetables that are commonly regarded as suitable articles of food, such as the several members of the cabbage tribe, spinach, lettuce, asparagus, and others, are valuable, not so much on account of the nutritious principles they contain, which are in small amount, but because of the *important inorganic salts* they supply, *especially the salts of potassium*, and because of the agreeable flavor possessed by many, and the wholesome variety and relish they give to our food. Their *antiscorbutic properties* are highly important. They contain a very large amount of water, often as much as or more than 90 per cent. The amount of nitrogenous substances which they contain is small, varying from about $1\frac{1}{2}$ to 4 per cent.

The Assimilation and Utilization of Food.—These processes will receive only a brief notice here, as they can be fully studied in the text-books on human physiology.

The first change which the food undergoes to prepare it for annexation and utilization is in the mouth, where it undergoes mechanical subdivision in the process of mastication, as well as admixture with the secretion of the salivary and other glands of the oral cavity. The mechanical division which the food undergoes in the mouth is an exceedingly important preparatory step to the further action of the digestive

juices upon it, as it multiplies the surfaces of contact and increases its permeability to the digestive fluids.

Through the agency of a diastasic ferment contained in the saliva, to which the name of *ptyalin* is given, the insoluble starch is converted into soluble dextrin, and subsequently into maltose, a form of sugar which is distinguished from grape-sugar by containing one molecule less of water. In the small intestines the maltose is converted into glucose.

Saliva acts best in an exactly neutral medium, but it also acts in an alkaline and even in a slightly acid fluid. Its action is, however, arrested or prevented by a strong acid; so that when the contents of the stomach are decidedly acid, and especially when it contains free hydrochloric acid, the action of the saliva on starch is arrested when the food reaches that organ. If the acidity be neutralized, the action is resumed.

The food when it reaches the stomach encounters the acid gastric juice, and by the agency of this digestive fluid the insoluble albuminates become converted into soluble *peptones*. This change is effected by the agency of a "hydrolytic" ferment, termed *pepsin*, which the gastric juice contains, together with free *hydrochloric acid*. The acidity of the gastric juice is, in health, not so great as is generally believed; indeed, its acid reaction is but slight, as the hydrochloric acid it contains enters into combination, for the time being, with pepsin and albuminates, and then no longer gives an acid reaction. The action of gastric juice on albuminates is first to cause them to swell up, and finally to dissolve them more or less completely. There would appear to be certain stages in this process. The large and complicated proteid molecule is split up by a process of hydration into simpler ones. The first stage is the formation of *syntonin* or *acid-albumin*, or *para-peptone*. This has the property of being soluble in acids, but it is again precipitated on neutralizing the solution. The next step is the formation of *hemi-albumose* or *pro-peptone*. This is coagulated by heat and is soluble in water. It is precipitated by nitric acid, but the precipitation is dissolved on heating and falls down again on cooling. Finally, by the continued action of the gastric juice the pro-peptone passes into true *soluble peptone*.

The true peptones have remarkable characters and properties by which they differ greatly from ordinary soluble albumin. They are not congulated by heat, or by nitric acid, or by acetic acid and potassium ferrocyanide. They diffuse easily through animal membranes. They have a cheesy taste, while albumin and albumose are tasteless.

The destination of the peptones, after absorption into the blood, is doubtless to replace the albuminous substances consumed in the organism.

It is a curious and interesting circumstance that when peptones are

injected into the general circulation they act as poisons; and this fact has naturally led to the inquiry why it is that, in health, the peptones in the intestine do not pass into the general circulation and exert their poisonous influence on the nervous system. To this inquiry no satisfactory answer can at present be given. As a rule, the peptones disappear from the portal blood before it reaches the general circulation; indeed, very little, if any, peptones can be found in it before it reaches the liver. Although it has not yet been discovered where the peptones undergo this remarkable change which renders them fit for appropriation as nutriment, it has been suggested that the liver may, to some extent, serve the purpose of preventing any peptones reaching the general circulation which may have escaped transformation in the blood of the portal system.

The food, reduced to the condition of *chyme*, when it passes out of the stomach into the duodenum encounters two other digestive fluids—the *bile* and the *pancreatic juice*. The acid chyme, meeting with these *alkaline* fluids, loses its acidity, and the further action of the pepsin on the albuminates is suspended. The pancreatic juice is one of the most important digestive fluids in the body, and it is the most energetic and general in its action of all the digestive juices, containing no less than four hydrolytic ferments: (1) *Amylopsin*, which seems to be identical with the ptyalin of the saliva, but is much more energetic, and can transform *raw* as well as boiled starch into sugar. At the temperature of the body this change is effected almost at once. Even cellulose is said to be dissolved by it, and gum changed into sugar. This ferment is absent, according to Korowin, from the pancreas of new-born children. (2) *Trypsin*, which digests albuminates, changing them, first, into a globulin-like substance, then into pro-peptone or albumose, and finally into true peptone like the pepsin-peptones, these peptones being sometimes termed *tryptone*. Trypsin is destroyed when it encounters pepsin and hydrochloric acid together; so that it is useless to administer trypsin by the mouth, as it would be destroyed in the stomach. (3) A *fat-splitting ferment, steapsin*. This causes neutral fats to appropriate a molecule of water and split into glycerin and these corresponding fatty acids, as, *e. g.*,

$$\overbrace{(C_{57}H_{110}O_6)}^{\text{Tristearin.}} + \overbrace{3(H_2O)}^{\text{Water.}} = \overbrace{(C_3H_8O_3)}^{\text{Glycerin.}} + \overbrace{3(C_{18}H_{36}O_2)}^{\text{Stearic acid.}}.$$

And (4) a *milk-curdling ferment*.

The pancreatic juice has the power of forming a *fine permanent emulsion* with fats. In this process the fats are subdivided into exceedingly minute particles, in which form they can be taken up by the lacteals. The fatty acid, set free by the fat-splitting ferment, enables the alkaline pancreatic juice to produce at once an emulsion, for the

presence of a free fatty acid causes emulsification to take place very rapidly.

It is seen, then, that the pancreatic juice exerts a solvent digestive action on all classes of alimentary substances—the albuminates, the carbohydrates, and the fats. Like the saliva it converts starch into dextrin and sugar, and like the gastric juice it converts insoluble albuminates into soluble peptones.

It has, however, been proved that the *bile* exerts an important influence in the absorption of fat, and that large quantities of fat can be absorbed without the presence of pancreatic juice in the bowels, provided only there be a free inflow of bile; but if bile be absent, then the absorption of fat is to a very great extent interfered with, notwithstanding the abundant presence of pancreatic juice; and so far from pancreatic juice being the sole agent in the digestion of fat (as was once taught), it is only when associated with bile that it is of any real value.

The *bile* is, then, an important agent in the digestion and absorption of fat. It aids the pancreatic juice in emulsifying fat, and it has a remarkable power in facilitating the passage of fat through animal membrane. If bile be absent from the intestine, a large proportion of the fatty matters of the food pass away undigested in the evacuations.

Besides the bile and pancreatic juice, the food when it reaches the small intestine encounters also the so-called "*succus entericus*," or intestinal juice secreted by the glands that are found imbedded in the intestinal mucous membrane. These are mainly Brunner's glands, which are confined to the upper part of the small intestine and Lieberkühn's follicles, which are closely packed throughout the whole length of the small and large intestine.

Since in the small intestine the food simultaneously encounters so many digestive secretions, it is almost impossible to limit accurately the particular part that each one plays in the processes of digestion. Experiments made out of the body cannot be arranged under precisely the same conditions as those which obtain within the alimentary canal, and conclusions drawn exclusively from such observations are exposed to obvious sources of error.

The *succus entericus* is said to be able to convert maltose into grape-sugar, and so to continue the diastasic action of the saliva and pancreatic juice; it is also believed to be able slowly to peptonize fibrin. It is probable that portions of the food may continue to be dissolved in the lower half of the small intestine under the influence of the various digestive ferments that have been mixed with it in the small intestine. In the large intestine the digestive processes cease, and putrefactive changes alone continue; the absorption of fluids, however, goes on, so that the contents of the large intestine increase in consistency as they advance along it.

The food has now been traced from its entrance into the mouth to its complete digestion in the small intestine: here the *dissolved* food-substances pass into the blood-vessels and lymphatics, and so enter the general circulation. The peptones immediately on entering the blood-vessels appear to undergo certain changes. They are taken up, to a great extent, by the red blood-corpuscles, and by a process of dehydration are converted back again, so to speak, into a larger and more complex albuminous molecule, that of *globulin*. "The blood-corpuscles thus form, as it were, a store of albuminous material, which they convey to all parts of the body and give off where it is wanted." A portion, however, of the peptones appear to have another destination: they are converted in the liver, where they are arrested, into glycogen. In the liver also the sugar absorbed from the intestinal canal is dehydrated and converted likewise into glycogen. There it is stored up for a time, and given out as required by the wants of the organism. The liver, therefore, is a great storehouse of carbohydrates, and it serves them out to the economy as they are required.

Food in Morbid States.—We are now in a position to pass on to the consideration of the relation that appropriate food bears to the treatment of disease.

In the management of all forms of disease a suitable adaptation of the food to the altered state of the diseased organism is of the highest importance; and we should pay especial regard to the state of the digestive and assimilative organs as influenced by existing pathological processes.

In many diseases, indeed in all febrile diseases, while the tissue-waste and therefore the demand for food is augmented, the capacity for digesting and appropriating nutriment is greatly impaired.

In these cases, moreover, the eliminative processes are also frequently gravely disturbed, and the exhibition of food containing much that cannot, under the circumstances, be utilized, leads to still further eliminative difficulties.

In diseases of the digestive organs we must ever keep in mind this disability, and remember that the essential conditions of alleviation and cure of such disorders may be the temporary withdrawal or limitation of food.

In other instances, where progressive emaciation is one of the most alarming incidents of the disease, our ingenuity should be directed to devising methods of feeding which, while they do not overtax the functions of the enfeebled digestive organs, tend adequately to restore the loss of tissue.

We must now consider these several conditions as they occur in connection with various acute and chronic diseases.

Food in Febrile Maladies.—The liberal administration of nutri-

ment in acute febrile disorders is popular at the present time, but it has probably been in many instances pushed to excess. The conclusion of some of the older physicians, that the administration of food tended to increase the fever in cases of acute disease, rested, no doubt, on some basis of practical observation, and it cannot be doubted that the careless and indiscreet administration of food, unsuitable either in quality or quantity, or in both, is most harmful in febrile maladies.

It is a universally acknowledged fact that all febrile states are accompanied by an increased waste or consumption of the tissues of the body, so that there occurs a considerable loss of body-weight, usually proportioned to the intensity and duration of the fever.

But the whole of this loss of substance is not necessarily due to the febrile process alone: whatever the intimate nature of that process may be, a portion of it is undoubtedly due to defective nutrition caused by the coincident disorder of the organs of digestion and assimilation which almost invariably accompanies fever. Not only is there absence of appetite and an indisposition to take food, but if food in any considerable quantity is given, it fails to be digested and assimilated, and only serves to intensify the febrile process and increase the discomfort of the patient. There are, therefore, two causes of waste co-operating in nearly all cases of acute febrile disorder: first, the abnormal increase of the metabolic processes, especially of the albuminous tissues, following as a direct consequence of the fever itself, and, secondly, the defective nutrition dependent on the coexisting morbid changes in the functions of the digestive and assimilative organs.

In most acute and severe febrile conditions the activity of the secreting glands of the stomach and intestines is so gravely impaired that the digestive powers are quite unable to keep pace with the destruction of the tissues; while that much of the waste is due directly to the febrile process seems to follow from the observation that the excretion of urea by a fever patient, even when absolutely deprived of food, will sometimes exceed by 40 to 50 grammes that of a healthy man with an ample supply of food.[1]

The principal facts to be borne in mind in approaching the consideration of the dietetics of fever are these:

1. Associated with the high temperature of fever there is rapid wasting of the albuminous tissues—an augmented consumption (or combustion) of the structural elements of the body.

2. As a consequence of the preceding there is an excessive excretion of urea, which is eliminated in the urine, but which may, for a time, accumulate in the blood. There seems to be also, although to a less degree, an increased excretion of carbonic acid.

[1] Bauer, *Dietary of the Sick.*

3. The fats do not appear to be used up to at all the same extent as the albuminates.

4. At the same time, the functions of the digestive and assimilative organs are greatly disturbed. There are morbid changes affecting the peptic and other secreting glands. These changes are usually accompanied by loss of appetite, and even disgust for food, and inability to digest solid food, which, if administered, is often vomited.

Bauer and Künstle, by careful observation of the diet of typhoid patients, have completely established the fact that by a due "supply of albuminous food to a fever patient a saving of albumin in the body may be effected; for, though the excretion of nitrogen is increased, the loss of the same element from the system is reduced."[1]

But Bauer, while he maintains that the loss of albumin in febrile subjects is lessened by the administration of albumin, concludes that it is unlikely it can be entirely prevented in highly febrile states; "for," he argues, "while under normal conditions a sort of equilibrium is constantly maintained between the nutrient fluids and the tissues, any excess of nutrient material being speedily removed, partly by increased metabolism and partly by an accession of substance, this equilibrium appears to be more or less disturbed in fever.

"The circulating current of albumin is abnormally great in proportion to the mass of cells; but the heated cells cannot assimilate this excess, since they have lost, at least in part, the capacity for taking up and turning material to their own use. A nitrogenous equilibrium cannot be attained in patients with high fever, even if they are in a condition to absorb large quantities of albumin. The possibility of compensating the loss of albumin by nourishment will be greater if the fever shows more or less marked remissions or intermissions, because, as it seems to me, the cellular elements recover during the intervals of remission the power of adding to their substance and of metabolizing the excess of nutrient material."

There are two principal rules which we should always keep in view in feeding patients who have febrile diseases:

First, to endeavor to utilize food to the greatest extent that is safe and possible for the purpose of checking the waste of tissue which is associated with the febrile process.

Secondly, to be careful to administer no food that cannot be readily absorbed and assimilated; for if we overlook the fact that the functions of the digestive organs are gravely impaired during fever, and if, in consequence, we give food that the patient is unable to assimilate, this undigested food will decompose in the stomach and intestinal canal, and cause irritation of the gastro-intestinal mucous membrane and augment the febrile movement.

[1] Bauer, *Dietary of the Sick.*

It is clear, then, that there is need for great discrimination in dealing with individual patients. In cases where the febrile process is not severe, or where there are distinct remissions or intermissions, and where the disturbance of the digestive organs is not considerable, we may give food with much more freedom and of greater variety, and in larger quantity, than in cases of high and continued fever with entire loss of appetite, and obviously great disturbance of the functions of digestion and assimilation.

Bauer especially insists that we should utilize periods of remission in febrile diseases, when they occur, for the more liberal administration of food, as the digestive powers are more active during these periods.

There is one other preliminary consideration we must also bear in mind—viz. that there is in some cases a tendency to accumulation in the body of the products resulting from the destruction of the tissues; and, as these act as poisons in the blood, we must be careful to administer such food as shall favor their elimination, and not lead to any increased accumulation of nitrogenous waste in the body.

We now pass on to the consideration of the best means of practically applying the important principles here set forth.

If the febrile attack is an acute and short one, there is no need for any anxiety as to the consumption of much food, unless old age or previous debility affords a special indication for actively supporting the bodily strength. By forcing the consumption of a considerable quantity of food in such cases, in the absence of all appetite and with obvious febrile disturbance of the digestive organs, more harm than good will be done.

All authorities are agreed that the food of fever patients should be in the *fluid* form, such as can be readily and immediately absorbed—that it should be given in small quantities and at short intervals.

Sir William Roberts observes:

"In forming a plan of dietary for the sick, distinction must be made between gastric and intestinal digestion. In healthy persons and invalids of the slighter sort we must have regard mainly to gastric digestion; but in the seriously sick the stomach often becomes inoperative, and digestion becomes almost exclusively intestinal. The sympathy of the stomach with the general condition of the system is much more active and close than that of the intestine: the former organ approximates more nearly to the animal life of the body, the latter more nearly to the vegetative life. The seriously sick, and especially the febrile sick, are often quite unable to take solid food. When the appetite and ability to take food are lost, they fail first with regard to meat, which is, so to speak, the specialty of the stomach, and next in regard to bread. Patients are then reduced to the use of liquid food—milk,

beaten-up eggs, gruels, jellies, beef-tea, and the like. In this latter condition the stomach loses its normal office, and becomes merely a conduit to pass on the liquid food to the duodenum. Not, perhaps, that there is, except in extreme cases, an absolute abeyance of gastric secretion and gastric action, but they are reduced to so low an ebb that they count for practically nothing in the work of digestion."[1]

Milk is the food most suitable for fever patients. It is a *complete* food; *i. e.* it contains all the elements needed for the nutrition of the body—albuminates, fats, carbohydrates, and salines; it is *fluid*, and it is relatively cheap, and always readily procurable.

It has, however, one great drawback. It is quite true that it is a fluid out of the body, but it is apt to coagulate to a *firm solid* within the alimentary canal, and this solid curd may pass undigested through the whole length of the intestine, and cause much irritation and injury in its course, especially in cases of typhoid fever, where there always exist inflammation and ulceration of the mucous membrane of the intestine. Patients with acute disease fed mechanically and carelessly on milk will often be found to evacuate from the bowel masses of undigested curd.

Moreover, some persons always digest milk with difficulty, while others digest it very readily. It is necessary, therefore, always to be on the watch for any signs of the indigestion of milk in cases of acute disease; and in these cases milk should always be given with certain precautions. It should be previously boiled. It should be given *diluted* —either with water or, better still, with an effervescent alkaline water, equal parts of milk and Vichy or Apollinaris or soda water. Milk thus diluted can often be absorbed when pure undiluted milk would be undigested. As a fever patient necessarily requires, as we shall presently see, much water as a beverage, we need have no hesitation in freely diluting his milk. The diluted milk should be given frequently in small quantities at a time. Two ounces of milk with two ounces of alkaline water every hour would give the patient two pints and a half of milk a day, and a fever patient requires a drink every hour. This quantity, of course, may be increased and the intervals lengthened in many cases. We are now speaking of cases in which the digestion of milk is difficult.

In instances where milk even thus diluted appears to disagree, it may be well to give an equivalent quantity of *whey*. This, of course, is milk from which the curd and much of the fat is separated by previous coagulation and straining. It can readily be made by boiling a pint of milk with a teaspoonful or two of lemon-juice, and then straining through muslin and expressing all the fluid from the curd.

If the curd be well broken up after coagulation and all the fluid

[1] *Dietetics and Dyspepsia*, p. 57.

thoroughly pressed out of it, much of the fat and some of the finely-divided casein of the milk will pass into the whey, and thereby greatly increase its nutritive properties.

This may be made more nutritious, if necessary, by adding strong beef-tea or meat-juice to it, or by the addition of the yelk of an egg previously whipped up with a little hot water and strained.

Bauer[1] recommends, in "cases in which cow's milk cannot be tolerated, even in small doses well diluted," that it should be replaced by "Nestlé's infants' food and similar preparations or Liebig's food for children."

Eggs, also a *complete* food, may be utilized in febrile diseases. They are best administered beaten up with *hot* water and strained, added to a little light broth or clear soup. A very nutritious food is thus prepared, or the yelk of an egg may be beaten up with a cup of hot tea, or given in the form of the brandy-and-egg mixture of the British Pharmacopœia.

Lightly-boiled eggs, or eggs beaten up in hot broth, have been given in typhoid fever by some German physicians, and with apparent advantage.

Valuable foods in febrile diseases are the various meat infusions, juices, extracts, etc., such as beef-tea, solutions of beef, meat extracts, mutton, veal, and chicken broths, clear soups, strong and weak, and those variously flavored with *vegetable* juices.

The value and usefulness of these foods, although contested by a few, have been almost universally admitted.

Bauer[2] expresses his approval of beef-tea and strong gelatinous soups as food for fever cases. He says: "By the addition of gelatin in proper proportion the nutritive value of the soup is greatly increased, without the risk of imposing any further burden on the digestive organs. Instead of clear broth we may use beef-tea, which always contains a certain amount of albuminous matter. That broth and meat extract contain but very small amounts of actual nutriment in no way lessens their value in the dietary of the sick."

Dujardin-Beaumetz maintains that the most suitable diet for febrile maladies is one that contains only a very small quantity of albuminous matter, and that it is the possession of *saline* and tonic principles, dissolved in a large amount of water, which constitutes the chief recommendation not only of broths and beef-tea, but also of milk. "For my part," he says, "I consider the value of milk in febrile maladies is due to the water and the saline substances it contains."[3] And again, "The milk and broth (*bouillon*) we give to typhoid patients enable us to ad-

[1] *Dietary of the Sick.*

[2] *Ibid.*; Von Ziemssen's *Handbook of General Therapeutics.*

[3] *Du Régime alimentaire dans les Maladies fébriles*, p. 225.

minister a great quantity of water, and also a notable quantity of saline matters;" and he refers to the observations of Robin to the effect that in typhoid cases there is a true "*mineral inanition* resulting from the daily losses of potash, sulphuric acid, phosphoric acid, and chloride of sodium, which pass away in the urine to the amount of 3 or 4 grammes of chloride of sodium, 1.50 to 2 grammes of phosphoric acid, and 2.967 of sulphuric acid, and 1.730 of potash;" and he compares this with the following analysis of "bouillon:"

Water	985.600
Organic solids left after desiccation in vacuo at 20°	16.917
Soluble salts, chlorides, phosphates, and sulphates of potassium and sodium	10.720
Salts very slightly soluble—phosphates of lime and magnesia	0.539
	1013.780

Practical experience seems to show that albuminous and gelatinous fluids, when they are not disagreeable to the fever patient—and it is an important matter to consult the inclinations and disinclinations of the sick—tend to support the bodily strength and lessen the risk of exhaustion; and we may therefore recommend in such cases either well-made clear soups and broths or the stronger beef-essences and beef-tea.

It has been an error to give these preparations of beef in too concentrated a form, in which they often prove repugnant to the sick; and seeing how needful it is to give considerable quantities of water to fever patients, there can be no good reason why some of the water should not be taken mixed with the other constituents of soups. Too little attention has also been given to the flavoring of the food of febrile patients. In the preparation of light clear soups it is easy, and indeed beneficial, to add some flavoring of aromatic herbs; and Sir William Jenner long ago directed attention to the error that is committed in omitting to add to such soups some vegetable juices. It is quite practicable to make clear soups which shall contain a considerable quantity of the expressed juice of fresh vegetables. Such vegetables as carrot, turnip, celery, parsnip, endive, lettuce, etc., together with some aromatic herbs, such as parsley, mint, thyme, or tarragon, if they are cut fine and placed in a muslin bag, and then boiled, yield a juice which may be added to soup: by doing this the soup or broth can be largely mixed with the juices of fresh vegetables, and become an important and wholesome article of diet.

The object of such a nitrogenous diet has been misapprehended by some of those who have argued against it; it has been said that it is useless to expect in acute fevers that albuminous foods can be utilized for the purpose of *tissue-formation;* they are not given with that object: they are given to check tissue-waste—to *spare* the tissues, or, to use the excellent French expression, as *moyens d'épargne;* and that they do act in that way practical observation has abundantly testified.

In prolonged cases of typhoid it is useful to add to the meat soups some *pulp of meat*, made by taking raw meat, depriving it of all its fat and fibrous structures, *scraping it fine*, and pressing the pulp through a coarse sieve; from one-half to three-quarters of an ounce of this should be given at a time, mixed with a cup of broth or clear soup (*Germain Sée*).

Cold meat-jellies and calf's-foot jellies may be given in moderate quantities.

Farinaceous foods containing carbohydrates—starch, sugar, etc.—can be suitably administered in various fluid forms. Thin oatmeal or barley gruel, carefully strained from all gritty particles and flavored with salt or grape-sugar and any agreeable spice or aromatic—as lemon-peel, cloves, nutmeg, etc.—is perhaps one of the best, and can be freshly made as required. It can also be mixed with milk, meat-essence, or beef-tea, and so form a useful composite food. A small quantity of arrowroot, ground rice, or well-baked flour can be added to clear soup or to beef-tea. Great care must, however, be taken that these are not made thick, but kept quite fluid. Such food is easy of digestion when given in small quantities at a time, and, by supplying a certain amount of "fuel-food," tends further to spare the tissues.

Grape-sugar, which is the substance that results from the digestion of carbohydrates, forming, in short, a kind of predigested carbohydrate, has been strongly recommended by G. Sée and other writers on dietetics as a useful food in fevers, and it may therefore be added with advantage to farinaceous foods and used also to sweeten beverages.

Barley- and rice-water are given chiefly as beverages, but they also, especially if sweetened with grape-sugar, afford a certain small amount of carbohydrates.

Tea and coffee given with milk and grape-sugar, serving both as food and beverage, may be usefully given from time to time to vary the repulsive monotony of the fever diet.

Bauer commends chocolate, "fine and as free as possible from spices, or cacao deprived of its fat and boiled with milk," as "well borne by most sick persons."

He also commends "fruit-soups" as "agreeable and useful;" they are "made by boiling fresh or dried fruits with water, with or without the addition of sugar, lemon-peel, etc., and freed from the solid residue" by pressing and straining. They are agreeable to some as beverages, and they contain a minute amount of albuminates, somewhat more carbohydrates, and some organic acids.

Next as to the most suitable beverage for febrile patients.

In the first place, a fever patient should be allowed to drink freely of water or of some beverage consisting almost wholly of water; much water is needed not only to replace the loss of water from the heated

body, constantly passing away by the cutaneous and pulmonary surfaces, but also to provide a necessary solvent medium to dissolve and carry away the waste products of the increased metabolism of the tissues. Such patients, even if they do not ask for drink, should be frequently offered either pure spring water or effervescing water or rice- or barley-water. When the temperature is high, *iced* water should be frequently given. Lemonade is highly commended by Dujardin-Beaumetz, who calls attention to the testimony of Maglieri to the decidedly febrifuge properties of lemon decoction.

Wine and water, even beer, and the use of alcohol in various forms are, more or less, commended in the dietetic treatment of acute diseases by most experienced physicians: our own opinion, however, is that alcohol is not absolutely needed in the *majority* of cases of acute diseases—viz. those cases that run an even, average course, without urgent or alarming symptoms. We do not consider that alcohol should be given, *as a matter of routine*, in all acute disease and in all stages of the disease; we prefer to hold it in reserve for the graver cases, or for the terminal stages of the average cases when the exhausting effects of the febrile process become especially evident.

The use of alcohol is especially indicated in the *adynamic* forms of acute disease in old age and also in infancy, as has been pointed out by Dujardin-Beaumetz. Those also who have been addicted to the habitual use of alcoholic drinks have more need of such stimulants when they are attacked with acute disease than those who have not been accustomed to their use.

But when young and robust persons of temperate habits become the subjects of acute febrile disease, they often do best with *no* or very little alcohol, at any rate in the early stages of the malady. Dujardin-Beaumetz, who has carefully studied the question of the physiological action of alcohol, gives the following concise and judicious summary of the various opinions that have been held as to its mode of action in acute disease, together with his own conclusions. "Some," he says, "see in alcohol a force-giving medicine which acts in febrile disease by sustaining and augmenting the strength of the patient; others regard alcohol as an antipyretic which lowers temperature and prevents hyperpyrexia; others maintain that alcohol hinders organic disintegration, while at the same time it augments the amount of oxygen inspired; while others assert that it acts simply as a food."[1] All these opinions may be considered true in their *ensemble*—that alcohol acts at the same time as a food, as a tonic, and as an antipyretic; and it is this threefold action which accounts for its favorable effects in the treatment of acute febrile maladies. "Alcohol is a food, and undergoes in the organism more or less complete combustion—a combustion, however, which takes place at

[1] *Du Régime alimentaire dans les Maladies fébriles*, p. 227.

the expense of the oxygen of the blood, and in that way it diminishes the pyrexial phenomena and lowers the temperature; it is *un aliment d'épargne.* It acts also on the nervous centres and affords them strength and tonicity, and is therefore a force-giver."

Alcohol may be given either in the form of a strong spirit, such as brandy or whiskey diluted with water, or in the form of port wine, or, occasionally, in the form of champagne. In continental countries the lighter wines are commonly employed. "In the General Hospital at Munich 150 to 300 grammes (about 5 to 10 ounces) of a light red wine are generally given to a patient with severe fever, or, if preferred, a like quantity of white wine;"[1] and in the hospitals of France the ordinary red wines of Bordeaux and Burgundy are used. Bauer recommends that the strongly alcoholic wines and concentrated spirits should only be employed when it seems necessary "to stimulate the heart to energetic action and to obviate a tendency to asthenia;" and he points out that "restlessness and irritability, followed by a degree of stupor," have often been observed to follow too large doses of strong alcoholic drinks; and he calls attention to the fact, which should certainly not be overlooked, that the continued use of alcohol in a concentrated form injures the activity of the organs of digestion. Beer he considers preferable in some cases to wine; "it is not," he says, "merely a stimulant, but also contains a certain amount of nourishment," and is much less costly than wine. In many cases in which there is no marked disturbance of digestion it may, he thinks, "be allowed without hesitation."

Brandy and whiskey, well diluted, are, in our experience, the best forms of alcohol to give during the acute febrile stage, and port wine or champagne during the period of convalescence, or, if the patient prefers a good claret or burgundy at this time, there is no objection to his having an equivalent quantity of these wines.

Food in Convalescence.

During *convalescence* from acute febrile maladies great care is still needed in the supervision of the diet. This is especially the case in convalescence from typhoid fever, when great firmness is often needed in resisting the patient's urgent entreaties for a more liberal and varied diet. The appetite is often voracious, and the craving for food, after the prolonged period of inanition he has passed through, is almost irresistible. But it must always be remembered that the digestive powers are still very limited, and that any solid food that escapes digestion in the stomach may act as an irritant in passing along the intestines, still the seat of slowly-healing ulcerative and inflammatory processes.

It has been again and again observed that the smallest indulgence

[1] Bauer, *Dietary of the Sick*, p. 232.

in solid food during the first few days of convalescence from typhoid fever is frequently followed by a rise of temperature and sometimes by a serious relapse.

It is needful, therefore, that for the first week or ten days of convalescence a fluid dietary should be maintained: a little well-soaked bread-crumb, rubbed through a fine sieve, may be added to clear soups or beef-tea, or these may be slightly thickened with ground rice or well-baked flour. The digestion of the patient must, however, be carefully watched for any symptoms of dyspepsia. More consistent farinaceous foods—rice, milk, sago, tapioca, arrowroot—may next be given in small quantities at a time, and small quantities of powdered meat may be mixed with clear soup or light broth. Custard puddings with fruit-jelly are nutritious and generally prove an agreeable change. Pounded *raw* meat is largely given by French physicians in convalescence from acute maladies, and is regarded by many as a most valuable restorative food. It is said by Fick to be three times as rapidly digested as cooked meat.

Robin, in his well-known work on the treatment of the complications and the convalescence of typhoid fever, gives the following *régime*, which seems to err on the side of liberality: "As soon as the morning and evening temperature have fallen below 100° F., give twice a day a soup with tapioca or semolina or some panada. At the end of two days, if the urine is free from albumin and excess of urea, add an egg to the soup and give a little meat jelly, but *no* bread. The fourth day increase the quantity of jelly or give some meat-juice (essence of meat), and in addition three to six small oysters and a few well-cooked prunes (!) at dessert. The fifth day order some light fish, such as whiting, and the pulp of a cooked apple. From the sixth to the eighth day you may permit a cutlet." Bordeaux or Burgundy to be taken at meals, mixed with effervescing water, and milk may be drunk between meals.

Food in Diseases of the Digestive Organs.

Acute Gastric Catarrh.—This is a common disease, and is caused usually by the action of improper and irritating food on the gastric mucous membrane. Any local irritant may, of course, excite inflammation of this membrane if brought in contact with it, and acute gastric catarrh is an almost invariable accompaniment of irritant poisoning; but the common and familiar forms of this disease are most frequently the result of improper feeding. Some persons are, however, much more predisposed to suffer from this disease, from comparatively slight causes, than others.

It has been pointed out that too scanty a secretion of gastric juice, by retarding digestion and favoring abnormal decomposition of food within the stomach, predisposes to this malady, and hence it is necessary

in febrile states, when, owing to the high temperature, there is much loss of fluid from the skin and lungs, and therefore diminished secretion of gastric juice, to diminish accordingly the quantity of food. The common custom of urging such patients to take more nourishment than they wish is often injurious, unwise, and unphysiological.

Generally, anæmic and feeble persons and convalescents from acute disease are also liable to attacks of acute gastric catarrh from taking more food than the small amount, or the altered and less active character, of their gastric juice is capable of dealing with, so that some of the undissolved ingesta decompose and set up irritation of the gastric mucous membrane.

Overloading the stomach with food, even in healthy persons, is a common cause of acute gastric catarrh, owing to the abnormal decomposition which the excess of ingesta undergoes. This is a frequent cause of gastric catarrh in young children, and especially in children at the breast, who are allowed, for the sake of quiet, to suck until they overload their stomachs.

Imperfect mastication also may give rise to gastric catarrh, as the food then reaches the stomach in a comparatively undivided state, so that the gastric juice comes in very imperfect contact with it, and hence portions remain undissolved and undergo decomposition. Rich and fat sauces and too much fat eaten with meat may lead to the same result, by covering or soaking the meat with an oily fluid which prevents the gastric juice from thoroughly penetrating it.

Food eaten when it is already in a state of decomposition may similarly give rise to gastric catarrh; and this is especially noticeable in delicate and sensitive persons. Game or fish kept too long, entrées made with meats that are not perfectly fresh, new beer and sour wine, and in young children milk that is not quite fresh, are fruitful sources of gastric catarrh.

Too free use of spices, stimulants, and condiments, and especially the habit of taking alcohol in a concentrated form, lead to the same result.

In *severe* cases of acute gastric catarrh the indication with respect to food is so to limit it in quantity and quality that the acutely inflamed mucous membrane shall be spared all irritation or excitement from ingesta, and the whole organ be, so far as is possible, put in a condition of physiological rest. Entire abstinence from food, at least from food taken by the mouth, may often be enforced with advantage for a day or two, or so long as the taking of food excites nausea or vomiting or severe pain. This abstinence is usually well borne, except in cases in which the strength has been exhausted by previous suffering and long inability to digest a sufficient quantity of food; in such cases nutrient enemata may for a time be given, so as to secure the rest needed by the

hyperæmic and irritated gastric mucous membrane; while small quantities of iced water may from time to time be taken into the stomach.

When, however, there is a great craving as well as a real need for food, fluid nourishment only must be carefully administered. In the selection of such fluid foods it must be remembered that the gastric secretion is alkaline, from admixture with mucus; that its digestive power is therefore greatly impaired; and that there is a great tendency to abnormal decomposition of food in the stomach. Milk, if given undiluted, or eggs, or any food requiring acid gastric juice for digestion, may be found to disagree with the patient. In such cases we should dilute the milk with an equal quantity of soda- or lime-water, and in some instances admixture with the alkaline Vichy water is preferable, as it seems to check the tendency to curdling of the milk and the formation of an irritating coagulum in the stomach. In some instances, where there is an obvious inability to digest the casein of milk, *whey*, freshly prepared, should be substituted for milk; and its nutritive qualities may be increased either by the addition of a little beef-essence or by shaking up the yelk of an egg with a little hot water and adding this in suitable proportion to the whey.

It is most important that all food used in these cases should be quite fresh and freshly prepared.

The *beef-essence* referred to is best prepared by cutting the lean of beef into small pieces and placing it in a wide-mouthed bottle securely corked, and thus allowed to stand for several hours in a vessel of boiling water. This may be given in teaspoonful doses to infants who cannot take milk, and in larger quantities to adults.

When we restrict patients to liquid food it is best to give it in small quantities at short intervals, and when there is much thirst it is better to allow small pieces of ice to be sucked than to permit large draughts of cold water to be taken.

In many of the less severe cases, while still adhering to a fluid dietary, we may provide the patient with a certain variety of food. When milk is well borne, either pure or diluted, raw or boiled, it forms the most convenient and nourishing basis of our dietary; but we may also prescribe carefully-prepared beef-tea, chicken or mutton broth, or *consommé* containing the expressed juice of vegetables boiled in it, and we may thicken these fluid foods with a small quantity of arrowroot, ground rice, or corn flour.

In cases accompanied with diarrhœa thickening the food with arrowroot will frequently be found very useful. When, owing to great physical depression, some stimulant is needed, small quantities of good brandy is the best stimulant to be given. It may be added to beef-tea, arrowroot, or milk, or given well diluted with soda-water. All wines are to be avoided; occasionally, however, a little champagne mixed with

soda-water agrees with some patients; in other cases a little weak tea acts as a useful and refreshing stimulant.

Some of the artificially digested peptonized foods answer well in certain cases, and we have known peptonized milk to be retained and digested when the smallest quantity of unprepared milk would at once excite vomiting.

Upon the disappearance of nausea, vomiting, and pains after food, and with the return of appetite and digestive power, a small quantity of solid food may be cautiously added to the diet, which should, however, still consist mainly of fluid food, and the return to the ordinary diet should be very gradual and carefully watched. It is best at first to add a little pounded beef or chicken to thin broths or clear soups, or to beat up the yelk of an egg with milk, or to add the yelk of an egg to a cup of warm *consommé*. Fragments of stale bread or toast may be soaked in hot milk or may be added to broth or beef-tea; but above all we should be careful to discard at once any article of food which is observed to excite any uneasiness.

On recovery, care should be had to avoid any of the exciting causes of gastric catarrh which we have mentioned, and only the lighter and more readily digested meats should be taken, and those sparingly and at sufficiently long intervals to allow of their complete digestion—boiled chicken or pheasant, the lean of boiled neck of mutton, well selected, the undercut of the sirloin of beef free from fat, boiled or soused sole or whiting or flounder, or, if grilled, they should be taken without butter or sauce, and with a little salt and pepper or lemon-juice.

Chronic Gastric Catarrh.—This is sometimes a sequel of the acute affection, and it may be caused by the same dietetic errors which we have already referred to as favoring the development of the acute disease. But probably the most frequent cause of chronic gastric catarrh is the abuse of alcoholic beverages, and especially the habit of drinking ardent or but slightly diluted spirits. Chronic gastric catarrh is also an almost inevitable accompaniment of any disease which leads to portal obstruction and consequent congestion of the gastric mucous membrane; it is therefore common to find gastric catarrh existing as a complication of hepatic disease and of those diseases of the heart and lungs which cause obstruction in the vena cava, and so hinder the outflow of blood from the liver and stomach.

It often accompanies pulmonary consumption, and it is always present in chronic organic disease of the stomach itself. It is important to bear in mind that in chronic gastric catarrh the mucous membrane of the stomach is commonly covered with a layer of grayish-white, tough, strongly adherent mucus.

The chief symptoms of this disease are those which are usually described as symptoms of *indigestion or dyspepsia*—viz. fulness, uneasi-

ness, and flatulent distension of the stomach after taking food. Gases are formed by abnormal fermentation and decomposition of the food, which is unduly delayed in the stomach, and these distend that organ, and are often eructated into the mouth, together with fragments of undigested food and rancid, sour fluids. Lactic and butyric acids are generated, chiefly from morbid transformation of starchy foods, and these acrid and sour fluids, when eructated, give rise to the uncomfortable hot feeling described as *heartburn*. In alcoholic cases there is often, especially in the morning, vomiting of a stringy tenacious mucus, or of a quantity of insipid fluid, or of a fluid which is sometimes described as "oily." This symptom is sometimes spoken of as "water-brash." Much of this vomited fluid is thought to be composed of saliva swallowed during the night. The appetite is usually greatly diminished or wholly lost, but sometimes there is an eagerness for food, which, however, is very soon satisfied. Constipation is a common accompaniment of this malady, and so is a condition of mental depression.

The dietetic treatment of these cases should be strict and systematic. In some instances, and especially in those which follow an acute attack, an exclusive milk diet often answers well, and will, within a moderate period, effect a cure. But it is always necessary to have regard to individual peculiarities in the digestion of milk, and not to insist upon this diet in persons who obviously suffer discomfort after taking it. Before giving it up, however, it may be advisable to endeavor to promote its digestion and assimilation by various means. The milk may be skimmed and much of its fat removed, if that should be the difficulty; or it may be boiled or diluted with hot water; or, what often proves of great service in promoting its digestion, is the addition to it of some alkaline water or one of the alkaline carbonates—one-third of Vichy water and two-thirds milk is a good mixture.

In cases of gastric catarrh produced by alcoholism, when accompanied with great thirst, we have seen excellent results in some persons from a mixture of equal parts of milk and Apollinaris water; and this has been taken in considerable quantity without the least difficulty, provided the tendency to constipation, which commonly accompanies a milk diet, be corrected by a dose of Carlsbad salts every morning before breakfast. Such a dose has the advantage of unloading the portal vessels, which are often engorged, and so tends to lessen the gastric hyperæmia.

Many German physicians have found that *buttermilk* suits some patients better than fresh milk, and we ourselves have observed the same fact in certain instances of chronic gastric catarrh.

Niemeyer quotes with approval the prescription, "When the patient is hungry, let him eat buttermilk; when he is thirsty, let him drink buttermilk;" and he suggests, as an explanation of the brilliant results

that sometimes follow its use, that fresh milk is perhaps "not so well borne because it readily curdles in the stomach, and forms large, firm lumps, while in the buttermilk the casein is already curdled, but finely divided."

The tendency to restrict patients who suffer from gastric catarrh to farinaceous foods is often a great error, for in numerous instances such foods lead to the formation of much lactic and butyric acids in the stomach, and help to aggravate the evil they are intended to mitigate. When, therefore, we prescribe farinaceous foods, we should carefully watch for signs of acid fermentation, and should they appear change to other food. In cases where they do not disagree they are valuable in moderate quantity, and light puddings made with arrowroot, sago, vermicelli, or ground rice, or clear meat soups slightly thickened with either of these, are useful articles of diet in such cases.

There is often a difficulty in digesting certain kinds of bread in persons with gastric catarrh, and it is not always easy to say why; but it will be found that bread obtained from the best bakers—bakers who are well known for the good quality of their bread and who take pains in its manufacture—will often be readily digested, whereas bread obtained indiscriminately will disagree.

Some kinds of whole-meal bread and of brown bread, now so much in vogue, we have found produce gastric irritation and acid fermentation in certain cases, when the finest and lightest and best-made wheaten bread has, in small quantity, agreed with the patient perfectly.

Thin dry toast will often be digested when ordinary bread will not.

All fat meat and sauces must be avoided, and all meats must be well masticated or mechanically reduced to pulp and taken in small quantities at a time. The digestion of animal food is certainly facilitated by a dose of some trustworthy preparation of pepsin.

When solid animal food is not well borne, concentrated meat soups containing a little of the crumb of stale bread may take its place with advantage. In some persons, very prone to the formation of acid, the lean of cold roast meat or fowl, finely divided and taken with a very little white bread, will sometimes suit better than any other food.

It has been noticed by many, and especially by Niemeyer, that some dyspeptics can digest salt and smoked meats better than fresh ones; and the explanation of this is that these preserved meats are less readily decomposed, and do not give rise to acid fermentation in the stomach. Niemeyer mentions that one of his patients who suffered from chronic gastric catarrh, with great tendency to acidity, knew exactly when he must abandon all other food and limit himself to the use of lean and smoked ham, sea-biscuit, and a little Hungarian wine.

Light-boiled eggs are a useful food in these persons. As the process of digestion is slow in these cases, ample time should be allowed for the

complete digestion of each meal. It is advisable also that the food, whether animal or vegetable, should be small in bulk, and this can be secured by carefully selecting the best portions of the lean of meat, chicken, game, or fish, and, if necessary, causing them to be finely divided. A certain amount of sound ripe fruit and *purées* of fresh vegetables are useful to counteract the tendency to constipation.

As we have already pointed out, the gastric mucous membrane is, in these cases, covered with a coating of adherent ropy mucus, and it is on this account that a glass of warm alkaline water, like that of Vichy, taken half an hour before a meal, promotes digestion, by loosening and washing away this tenacious layer of mucus, clogging, as it does, the orifices of the gastric glands. The employment of an *exclusively milk diet* in the chronic gastric catarrh induced by abuse of alcohol is strongly advocated by Dujardin-Beaumetz, who also insists on the value of the addition to the milk of some alkaline water or bicarbonate of sodium.[1]

Gastric Ulcer.—The rules that should govern the dietetic treatment of cases of *ulcer of the stomach* are few and simple.

In the first place, we must avoid all food that can, either mechanically or chemically, irritate the surface of the ulcer.

Secondly, we must avoid the use of food that is calculated to stimulate the acid secretions of the stomach, for this will act as an irritant to the raw, ulcerated surface.

Thirdly, we must avoid *distending* the stomach with much food at a time, for by maintaining the stomach in a contracted state, its mucous membrane is thrown into folds, so that the margins of the ulcer are relaxed and its extent diminished—conditions favorable to the filling up and healing of the ulcer.

Fourthly, any excitement of the muscular movements of the stomach should be, so far as possible, prevented.

Lastly, in cases of perforating ulcer, in which severe and dangerous hæmorrhages have occurred and may recur, the stomach should be kept absolutely at rest for two or three days at least, and the patient fed with nutrient enemata, to which, if necessary, a little brandy or port wine may be added, allowing only a few fragments of ice to be sucked in order to allay thirst.

In most cases restriction to an exclusively milk diet will fulfil these indications, and to prevent any firm coagulation of the casein of milk in the stomach we should add some alkaline carbonate or alkaline solution to the milk. In many instances mixing the milk with an equal quantity of lime-water is sufficient, or Vichy water may be used instead. Some physicians, to avoid this curdling of the milk in the stomach, give buttermilk instead of fresh milk. Niemeyer found malt

[1] *L'Hygiène alimentaire*, p. 211.

extract a useful food in these cases, and, as a good form of vegetable food, *purée* of potatoes.

If there is a distinct intolerance of milk diet, small quantities of meat or chicken may be given, finely divided or reduced to a pulp (the lean only), and mixed with a little weak broth or *consommé.*

Leube's soluble meat is much used in these cases in Germany. Leube gives some milk also and well-soaked bread. The soluble meat is mixed with slightly salted broth and taken lukewarm.

In those serious cases in which dangerous hæmorrhage has occurred the patient should be kept in bed and fed by nutrient enemata.

If, after a fortnight or three weeks of this strict feeding, the symptoms of the disease have disappeared, we should permit a gradual return to more solid food—the lean of tender boiled mutton or chicken, boiled sole or whiting, light milk-puddings, and vegetable *purées;* but we should be careful strictly to limit the amount taken to that required to satisfy the physiological needs of the body.

Stimulating beverages taken by the mouth should be wholly avoided. A little weak tea, with milk, may be permitted in some instances.

Cancer of Stomach.—In this disease the indications are to supply as much nourishment to the body as will adequately meet the nutritive demands and check the progressive emaciation, while at the same time we reduce to a minimum the work of gastric digestion and the pain that is usually attendant upon it. To do this we must give food in such a form that it can be readily absorbed by the vessels of the stomach itself, and cause little or no irritation by its presence there, or food that can readily pass out of the stomach and be absorbed lower down in the alimentary canal.

One important point to keep in view in the feeding of cases of cancerous stricture of the pylorus is to give such food as can be digested and absorbed in the stomach (or predigested food), which will not have to be passed through the narrowed pyloric outlet in order to be digested lower down. It is therefore necessary to avoid, in these cases, starchy, farinaceous foods, unless they are predigested, for they cannot be digested in the stomach, and there is difficulty in their passing out of that organ: the result is, that they are retained there, and give rise to the development of lactic and butyric acids, set up much pain, and lead to troublesome nausea and vomiting.

If the cancerous growth should involve some other region of the stomach, there is then not the same objection to the carbohydrates, because there is not the same risk of their being retained long enough to undergo abnormal decomposition in the stomach.

Food in cancer of the stomach, speaking generally, should be fluid, and sufficiently concentrated to supply the necessary nourishment in a *small* bulk. When milk is well borne no better food can be taken. It

is well, however, to dilute it slightly with some alkaline water, and peptonized milk will often be found to agree when ordinary fresh milk will not.

Should any considerable hæmorrhage from the stomach occur during the course of the disease, it may be necessary to limit the administration of food for a time entirely to nutrient enemata, so as to keep the stomach free from any irritation or functional excitement.

As a beverage a little red wine appears to be well borne; beer, spirits, and all sweet and effervescing wines should be avoided.

If the cancerous growth has attacked the cardiac orifice, then nothing but fluid food should be given, as solid food would be arrested above the stricture and cause dilatation of the œsophagus. If the stricture is considerable, it may be advisable to introduce food into the stomach through a tube or to have recourse to rectal alimentation.

Dilatation of Stomach.—Apart from other therapeutic measures, a strict enforcement of dietetic rules is highly needful in this disease. It is especially important to forbid overloading the distended stomach with food; the food should be concentrated and small in bulk. The supply of liquid should be strictly limited; not more than from 6 to 8 ounces should be taken at each meal. To check any craving for fluid during the meals a teacupful or more of hot water may be sipped half an hour before a meal.

As it is desirable that the food should be concentrated, it must be chiefly animal. The lean of meat from which all fibrous and tendinous structures have been removed is the best.

Starchy foods should be taken only in small quantity, as they are prone to linger in and set up abnormal fermentations in the dilated stomach. Most vegetable substances calculated to give rise to flatulence must be discarded; fresh vegetables must only be taken in limited quantity and in the most concentrated and digestible form. Those that can be taken in the form of *purées* are the best.

Only in severe cases, associated with troublesome vomiting, is it necessary to adopt for a time a strictly milk diet, and in these cases the milk should be given with crushed ice.

Dyspepsia and Indigestion.—The symptoms and causes of dyspepsia need not be dwelt upon here; they are much the same as those of chronic gastric catarrh. As defective mastication is often the cause of certain forms of dyspepsia, either from defective teeth or from carelessness or inattention to this process, food should be given that does not require much mechanical effort for its disintegration—*e. g.* the crumbs of stale bread, dry toast, and some kinds of biscuit, which crumble down and disintegrate readily, whereas new bread is apt to form tough, coherent masses in the mouth. Vegetables should be mashed or reduced to the form of *purées;* potatoes, especially, unless very "mealy," are apt to

escape thorough mastication, and to be swallowed in lumps which are likely to prove a source of irritation from abnormal decomposition lower down in the alimentary canal. Fat also should not be eaten in lumps, but should be finely divided and mixed with some other food which will keep the fragments apart. "Bread and butter" is an example of this. When, owing to defective teeth, mastication becomes painful, the meat taken should be first reduced to a pulp or minced or pounded.

Persons with feeble digestions should prefer the shorter-fibred and more easily disintegrated meats and fish: mutton, chicken, pheasant, and partridge are better than beef, goose, duck, wildfowl, etc. Veal and pork are notoriously difficult of digestion, and lamb and rabbit are not so easily digested as some persons believe. Of fish, the sole, whiting, and flounder, when plainly grilled or boiled, are far more digestible than the firmer-fleshed and richer fish.

Grilled (not fried) fat bacon eaten with dry toast often proves an easily digested and good form of fatty food. It disintegrates readily, is savory, and mixes well with bread; accompanied by the yelks of one or two poached eggs, it forms a nutritious and compact meal.

As we have before had occasion to remark, any food saturated with fat, which prevents the penetration of the gastric juice, such as buttered toast, muffins, pastry, etc., sweet dishes that are apt to undergo acid fermentation, and unripe acid fruits, nuts, and the hard coverings of vegetables containing much cellulose, are difficult of digestion and must be avoided.

It is exceedingly important that the food of the dyspeptic should be carefully and skilfully cooked and agreeably flavored; if food is made palatable and appetizing, it stimulates the nervous system, and so promotes gastric secretion and digestion: grilled meats are perhaps the most digestible and savory.

As to sauces, it is best for the dyspeptic to avoid all rich sauces entirely, and when butter is required, as with fish, to use plain fresh butter.

The indigestibility of bread, or rather of certain kinds of bread, and of too large a quantity of bread, is often overlooked.

A bread which breaks "short," is porous, and crumbles easily, which is not too moist, and yet which does not dry too quickly, and which *does not become glued together* in the mouth in mastication, is the best.

Another point of extreme importance to the dyspeptic is that the meals should be small or very moderate in quantity. Our object should be to select a diet which, while it affords the necessary amount of nourishment to the body, imposes the smallest amount of labor on the stomach.

The food should be slowly and deliberately eaten.

A sufficient amount of time should also be allowed between the meals to permit of the complete digestion of one meal before the next is taken. When the patient is unable to take any solid food, then no doubt it is necessary to take small quantities of fluid food at short intervals; but when solid food is taken, as at an ordinary meal, it must be remembered that from five to eight hours, according to the amount and nature of the food, is needed for its digestion, especially in advanced life and in cases of feeble digestion.

The free use of stimulating beverages, alcohol, tea, coffee, etc., must be forbidden. Whenever there is a craving for alcohol, it is best to forbid it entirely; but in non-alcoholic cases of atonic dyspepsia a small amount of good pure wine, with or without water, or a little weak brandy or whiskey and water, or, if preferred, some effervescing table-water, often serves as a useful stimulus to gastric secretion.

With respect to the use of tea and coffee by dyspeptics much difference of opinion exists. That excess in either, and sometimes quite a moderate quantity, will excite dyspeptic states in some persons under certain conditions is absolutely certain. Much, however, depends on the time at which they are taken. A person with a feeble digestion should not take them with or soon after food; as they will often retard digestion under these circumstances; but a small cup of weak unsweetened tea or light coffee three or four hours after a meal will not unfrequently be found to promote the final stage of stomach digestion; no food, however, should be eaten at the same time, as is so commonly done. In cases in which even at this distance from a meal they appear to interfere with digestion, it is a good plan to sip a teacupful of hot water instead. Light China teas are much less likely to cause dyspepsia than the stronger Indian varieties.

In anæmic and atonic cases a moderately stimulating dietary answers best, and animal food and soups, well selected and pleasantly flavored with suitable condiments, are better digested than farinaceous foods, which have a tendency to undergo acid fermentation. The meat should be tender and not overcooked. A purely milk diet, which often proves so beneficial in cases of gastric catarrh, is not sufficiently stimulating for the cases we are now considering.

In all these cases individual peculiarities must be carefully studied, especially as to the ease or rapidity with which particular articles of food can be digested.

The cooking should be as simple as possible, so that the natural flavor of the food will be preserved, and any agreeable condiment may be added in moderation; all twice-cooked meats should be avoided.

Green vegetables, unless in very small quantity, especially of the cabbage tribe, should be eschewed, as they are very prone to give rise to flatulence.

Dujardin-Beaumetz, in order to simplify the construction of appropriate dietaries for dyspeptics, divides them into three groups:[1]

1. Those in whom the secretion of gastric juice is abnormally abundant. For these he prescribes a purely vegetable diet—farinaceous substances, fresh vegetables, and fruits. Milk may be used as a beverage, and sometimes beer, but never wine.

2. Those in whom the gastric secretion is deficient. For these he orders meat and meat-broths; but the meat should be reduced to pulp or powder, and the quantity carefully limited to the digestive capacity of the patient. Milk is also admissible, as it augments the digestive power of the stomach by the presence of lactic acid; he also approves of the addition of milk to meat-broths. Wine or weak brandy-and-water he allows, as calculated to increase the acidity of the gastric juice. Peptonized foods may be advantageous in certain individuals.

3. Those dyspeptics who are troubled with sympathetic affections as giddiness (*vertige stomacal* of Trousseau). For this class he considers it important to lessen the possibility of any excitement proceeding from irritation of the gastric mucous membrane; and to carry out this indication he urges the adoption of a purely vegetable dietary composed of farinaceous foods, fresh vegetables, and fruits, permitting milk as a beverage.

The following is a detailed account of the vegetarian dietary, the adoption of which he considers so important in the case of many dyspeptics:

Bread.—Crust of bread or dry toast.

Farinaceous Foods.—*Purées* of potatoes, of haricots, and of lentils; revalenta; maize flour; chestnut meal; oatmeal; pearl barley, macaroni, and vermicelli; these may be taken plain or with butter.

Fresh Vegetables also in the form of *purées*—carrots, turnips, and the other vegetables used in making Julienne soup; *purée* of green peas, well-cooked salads, spinach, sorrel, French beans.

Fruits should, with the exception of grapes, be cooked, and taken as *compôte*.

With such a *régime* he permits slightly-cooked eggs, and he does not forbid beer.

Leube has found the four following dietaries applicable to the different degrees and stages of digestive disorders. No. 1 is considered to be the most easy of digestion, and is suitable, therefore, to the most severe cases of dyspepsia; No. 2, the next easiest, and so on up to No. 4:

No. 1.—Broth, or clear soup (*bouillon*).
Solution of meat (Leube's special preparation).
Milk.
Eggs, raw or very slightly cooked.
As beverage.—Water, either pure or slightly charged with carbonic acid gas.
This diet is prescribed for cases of gastric catarrh at the outset.

[1] *L'Hygiène alimentaire; Du Régime spécial dans les Maladies de l'Estomac.*

No. 2.—Boiled calves' brains, soups, etc., as in No. 1.
" " sweetbread.
" chicken.
" pigeon.
" bread-and-milk (pap).

No. 3.—The articles in Nos. 1 and 2, to which may be added—
Beef (rump) steak, very underdone, and raw ham (!)
The steak is to be thoroughly beaten, to make it tender, and the most tender portions scraped away with a spoon and roasted quickly in fresh butter.
A small quantity of white bread.

No. 4.—Contains a variety of meats.
Roast chicken, pigeon, partridge, venison, underdone beef (especially cold), veal, macaroni.
A small quantity of wine is allowed with this diet, and also a very small quantity of green vegetables, salad, and stewed fruit.

Constipation.—Sedentary habits and insufficient bodily exercise, by lessening peristalsis of the muscular coat of the bowels, are well-known causes of habitual constipation.

A too-exclusively nitrogenous diet—a diet too largely composed of easily-digested animal food—by leaving but little waste after its digestion, may lead to constipation from the absence of the stimulus to the nerves of the intestinal mucous membrane which a normal amount of indigestible residue produces; or by too exciting a diet and the repeated contact of a too stimulating residue the excitability of the intestinal nerves may be exhausted and constipation thus induced.

In some instances too dry a diet is taken, and not enough water is consumed to keep the contents of the intestinal canal in a fluid, semi-fluid, or soft condition.

The freer the supply of water to the blood, the more fluid the intestinal secretions are likely to be; whereas if the supply of fluid to the blood be limited, less fluid is likely to be secreted from the intestinal glands, and the intestinal mucous membrane will become dryer. It is no doubt for the reason here indicated that free draughts of cold water taken at bed-time and in the morning fasting will often succeed in overcoming habitual constipation.

Persons who lose much water from the skin by profuse perspiration should also remember this if they suffer from constipation.

Persons who avoid fresh vegetables and fruit should be induced habitually to add some of both to their diet.

Green vegetables and ripe or stewed fruits—as apples, pears, prunes, figs, etc.—and the various kinds of brown or whole-meal bread are well known to have an aperient tendency. This is due to the mechanical irritation which the undigested residue of such foods excites in the intestinal mucous membrane.

Eggs, milk, and most of the farinaceous foods, as they leave but

little stimulating residue from their digestion, tend to aggravate the constipated habit.

Oatmeal and maize are also reputed to be slightly aperient, and honey or treacle added to bread or other farinaceous food favors peristaltic action.

"Bran-bread, green vegetables, salads, spinach, sorrel soup (*soupes à l'oiselle*),"—these are the foods containing much indigestible cellulose, which Dujardin-Beaumetz[1] recommends for the relief of habitual constipation, to which he adds "gingerbread (*pain d'épice*)—which, taken in large quantity, is very decidedly laxative"—grapes in quantity, oranges taken with alkaline (Vals or Vichy) water, and *linseed.* "Pour," he says, "a little water on a dessert- or tablespoonful of linseed, let it stand for an hour, and drink the whole immediately before a meal."

Spanish or Portuguese onions, plainly boiled, will often be found to promote the action of the bowels.

Diarrhœa.—Diarrhœa may be acute and temporary or it may be chronic and intractable.

There is one general dietetic rule that applies to every case of diarrhœa, and that is to avoid all foods which leave much undigested residue behind, and which may therefore tend to produce irritation of the intestinal mucous membrane. We should select and prescribe only such foods as leave a bland and unirritating residue as a result of their digestion, and which ordinarily have no tendency to undergo decomposition into irritating acid substances in the alimentary canal.

Especially to be avoided are green vegetables, raw acid fruits, nuts, potatoes (unless in the form of *purée*), coarse brown bread, and all rich, fat, or acid dishes; also all forms of animal food which are hard or tough and difficult of digestion, such as pork, veal, and beef, unless reduced to pulp or powder.

Milk, preferably boiled, is usually a good food in diarrhœa, unless we find some individual peculiarity rendering it difficult of digestion, and in such cases we must order farinaceous foods, such as arrowroot, tapioca, sago, rice, etc., made with water and flavored with nutmeg, cloves, or cinnamon. An acute attack of diarrhœa will often be rapidly cured by restricting the food for twenty-four hours to very thin arrowroot flavored with the spices we have just named, and with the addition of two or three teaspoonfuls of brandy or a teaspoonful or two of port wine to each teacupful. When beef-tea or clear soup is ordered in these cases, it should be thickened with arrowroot, sago, or tapioca.

Soda-water and milk, with a small quantity of brandy, is the best beverage in acute cases, or port wine and water may be substituted when preferred.

After the subsidence of the acute attack the return to the ordinary

[1] *L'Hygiène alimentaire.*

diet should be gradual, and for a few days clear soup or beef-tea, thickened with the substances we have named, boiled chicken, partridge, or pheasant with rice, or boiled whiting or sole and a little mashed potato, should be the chief articles of diet. All acid wines and beers must, during this period, be prohibited. The tannin wine of S. Raphael may, however, be permitted.

The dietetic treatment of chronic diarrhœa is a somewhat more troublesome matter. According to Dujardin-Beaumetz,[1] the four following means are those chiefly to be relied upon: 1. Milk; 2. Raw meat; 3. Peptonized foods; and 4. Powdered meat.

A strictly milk diet, according to this author, if rigorously followed, will cure all forms of chronic diarrhœa but one, and that is the diarrhœa of tuberculous ulceration.

After the diarrhœa has been overcome by a strictly milk diet, he allows raw meat, but prefers powdered meat, which is, however, to be given with great caution and increased in quantity gradually and slowly. Peptonized foods may also be tried, and in some instances they may be found to agree better than raw or powdered meat.

As the cure becomes established a gradual return to ordinary diet, especially selecting easily-digested kinds of food, may be permitted.

In the diarrhœa of infancy milk is also the proper remedy—pure fresh milk diluted with lime-water.

It has been shown by Hayem[2] that the "green diarrhœa" (*diarrhée verte*) of infancy is microbic in character, and that it is necessary to disinfect the soiled linen in order to avoid its propagation to other infants. He recommends the administration of a two-per-cent. solution of lactic acid, a teaspoonful to be given a quarter of an hour after suckling.

G. Sée[3] is also a strong advocate of the use of raw meat in the treatment of cases of chronic diarrhœa. He says the fibres are "less compact, softer, and less irritating" than meat cooked in any way; as to the value of milk in these cases he speaks highly, but insists that it should be given in small quantities, and that it should be "skimmed, boiled, and diluted with water," for large quantities of *rich* milk will, he maintains, often augment diarrhœa.

Dr. Stange advocates the koumiss cure in some cases of chronic diarrhœa, and he mentions one case which persisted after an attack of epidemic dysentery, and in which different modes of treatment had been tried for four years; "but the slightest indiscretion in diet invariably brought on the diarrhœa. Six weeks after the commencement of the koumiss cure he had gained four kilos., and could take any kind of food with impunity."[4]

[1] Op. cit.

[2] *Académie de Méd.*, 17 Mai, 1887.

[3] *Du Régime alimentaire.*

[4] Von Ziemssen's *Handbook of General Therapeutics*, vol. i.

Diabetes.—In the treatment of this disease dietetic measures are of chief importance. The normal metabolism in the body of saccharine and starchy, and in some instances, it would seem, even of albuminous, food, is, for some reason or other, disturbed, and the consequence is that sugar, in greater or less quantity, appears in the urine.

In a state of health the starchy and saccharine substances, which form important constituents of our daily food, undergo complete conversion in the system. The starch is converted into sugar, and this, together with the sugar taken as such into the stomach, is, after absorption, wholly consumed and utilized in the body. None, or practically none,[1] passes out of the healthy body as sugar. In the disease known as diabetes it is otherwise. In this disease a more or less notable quantity of sugar escapes in the urine, and we find from observation that the amount of sugar which appears in the urine is proportioned to the amount of saccharine and starchy substances taken in the food. In the more serious forms of this disease it is found that sugar may be discharged in the urine even when no starchy or saccharine substances are taken in the food; and it is therefore certain that in some instances of this disease sugar is formed within the body from other substances than the carbohydrates of the food—that, in short, nitrogenous matter can undergo transformations which result in the production of sugar.

In health the sugar which is taken into or formed within the organism is doubtless directly or indirectly utilized in the production of force; in diabetes it escapes from the body unconsumed. This is the essential feature of the disease.

We are not directly concerned here with the pathological theories that have been advanced to account for the diabetic state: our present purpose is the practical one of determing the most suitable kind of food for diabetics, so as to arrest or check their glycosuria, the amount and persistence of which may generally be taken as an indication of the gravity of the malady.

The principal rule which should govern the construction of a dietary for the diabetic is to exclude from it, so far as possible, all those articles of food that can be converted in the organism into sugar.

Having composed such a diet and applied it to any particular case of diabetes, the prognosis of that case will, in a great measure, depend upon what we observe to be the result of that diet: if the amount of sugar in the urine diminishes rapidly in quantity and ultimately disappears, the prognosis is favorable; if it persists or diminishes but slightly in quantity, the prognosis is unfavorable.

Following Dujardin-Beaumetz, we may classify cases of diabetes under three forms:

[1] Pavy maintains that a minute quantity of sugar can always be detected in the urine if we employ sufficiently delicate tests.

(*a*) Slight cases;
(*b*) Cases of medium intensity;
(*c*) Grave cases;

and, so far as the results of feeding are concerned, this is an useful division.

The adoption of a suitable diet will often, in the "slight cases," bring about a rapid and remarkable disappearance of the *glycosuria*. Dujardin-Beaumetz states that he has seen a great number of diabetics who were passing from fifteen hundred to three thousand grains of sugar per diem, and in whom after eight days of dietetic treatment the sugar wholly disappeared from the urine. The slightest infraction of the prescribed diet would, however, be attended with a reappearance of sugar in the urine.

In the second group of cases, the cases of medium intensity, the application of a suitable diet will considerably lessen the quantity of sugar in the urine, but will not cause it to disappear completely; from one hundred and fifty to three hundred grains, perhaps, being excreted daily. These were termed by Bouchardát, *petits diabêtiques*.

It is in the treatment of these two forms of diabetes that the use of the natural alkaline mineral water, in addition to a suitable dietary, proves of such remarkable value.

In the third group of cases, the "grave" form of diabetes, such as we usually find presented by young persons when attacked with this malady, the treatment by diet is not attended with such good results.

These patients are usually thin and tend to emaciate rapidly, and even when deprived of all carbohydrates and restricted to a purely nitrogenous dietary, they will still continue to excrete a considerable quantity of sugar in their urine. They appear to form sugar out of nitrogenous substances, and even to transform their own muscles into glycogen and urea. These cases usually run a rapid course to an inevitably fatal termination.

Which is the best dietetic treatment to be applied to these cases of diabetes?

The shortest dietetic rules may be enforced with advantage, in the case of the stout, gouty, glycosuria patient, but with the wasted, ill-nourished, *true* diabetic the case is otherwise, and our difficulties in the matter of diet are great; for not only have we to consider how to check or arrest the amount of sugar that he forms and excretes, but we have to attempt the even more difficult task of maintaining and improving the seriously damaged general nutrition.

It is generally admitted that the *carbohydrates*—*i. e.* all food-stuffs containing glucose or whatever can be converted into glucose in the organism—should be, so far as is possible, excluded from the diet of

diabetics, and that they should be fed as exclusively as possible on albuminous foods and fat.

"In diabetes mellitus the sugar introduced with the food or formed within the organism is only imperfectly applied in the animal economy, since a greater or less proportion of it is washed out of the body with the urine, without having undergone the normal splitting up. The *sugar and the sugar-forming substance must therefore present in the body of the diabetic the character of useless ballast.*"[1] Clinical observation also shows that the amount of sugar excreted in the urine, so far as it is dependent on the diet, exercises a great influence on the patient's well-being.

The fearful thirst of the diabetic patient is determined by the amount of sugar in the blood, and we can only hope to relieve the former by a diet which will also tend to diminish the latter; and although it is true, as has been stated, that in severe cases sugar will still appear in the urine, notwithstanding the entire withdrawal of carbohydrates from the food, yet it does so in diminished quantity, and this result is a gain.

The inability of the diabetic to utilize the carbohydrates, which form so large a proportion of the ordinary mixed dietary of the healthy, makes it necessary, if his nutrition is to be maintained, to replace these by an equivalent amount of other food-stuffs; and in severe cases a portion even of these is wasted and excreted in the form of sugar, so that it becomes an exceedingly difficult problem, in dealing with the severe forms of this disease, to supply the patient with enough readily digestible food to compensate for the abnormal waste, as well as to maintain the normal nutrition of his body. These considerations amply account for the craving for food which the majority of diabetics experience.

It would seem, from the observations of Külz,[2] that all the carbohydrates do not increase the secretion of sugar, and that it may be possible, as suggested by Bauer, to utilize some of them in relieving the dread monotony of the diabetic diet; and he states, on the authority of Külz, that mannite, fruit-sugar (levulose), inulin, and inosile have no effect in increasing the sugar in the urine. It is very possible that not quite enough attention has been paid to the individual peculiarities of diabetics in framing their dietaries, and that certain carbohydrates may be well tolerated by some and not by others.

Fothergill,[3] who was himself a diabetic, calls attention to this point, and he asks: "Are not sometimes slight divergences from the rule permissible? Though milk does contain sugar, is it always advantageous

[1] Bauer, *Dietary of the Sick;* Von Ziemssen's *Handbook of General Therapeutics*, vol. i.

[2] Quoted by Bauer in *Dietary of the Sick*, p. 296; Von Ziemssen's *Handbook of General Therapeutics*, vol. i.

[3] *Manual of Dietetics.*

to bar it? . . . . Sometimes milk may be allowed freely, and the same may be said about ordinary bread;" and he mentions the case of a glycosuric patient who passed urine "absolutely free from sugar, yet at that time she was living upon vermicelli pudding and arrow-root"; and he mentions another instance, that of a glycosuric physician, who improved greatly on "raspberry jam."

The chief principle to be kept in view in determining the dietary of the diabetic is this: that by an exclusively animal diet the excretion of sugar in slight cases may be entirely suspended, and even in severe and advanced cases kept at a lower figure. Speaking generally, albuminates and fats should form as far as possible the sole food of the diabetic, and the severer the case the more rigid should be the application of this rule. Some concessions will, however, have to be made to the feelings and wishes, and even occasionally to the actual well-being, of the patient. It would seem, from some of Külz's experiments, that the power of utilizing sugar in the system is not *wholly* lost in this disease; and Külz has stated that some of his patients were able, even in advanced stages of the disease, to metabolize large quantities of sugar. He also ascertained that muscular exercise greatly increased the metabolism of sugar in the organism of the diabetic, and lessened its excretion to a corresponding extent.[1] Other observers have, on the other hand, noticed that in the grave forms of diabetes muscular exercise has been badly borne.

Besides the objections which diabetic patients themselves make to a diet composed exclusively of meat and fats, it is highly probable that such an exclusive diet may be itself injurious to some of them. It certainly tends to aggravate the tendency observed in many diabetics to an increased excretion of the nitrogenous elements of the urine, and especially to the formation of uric-acid deposits, to which some of them are prone. It has also been stated by Ebstein and others that an exclusively animal (meat) dietary favors the development of acetone in the blood.

With regard to the admissibility of milk in diabetes some differences of opinion exist. Many physicians (Bouchardát, Germain Sée, Dujardin-Beaumetz) discard it entirely. There are, however, others who have not found milk so injurious to all their diabetic patients. Bauer considers that it may be permitted, but only in moderation, and he refers to the remarkably diverse results of Külz, who found that in some of his diabetic patients milk-sugar caused a "relatively considerable increase" of sugar in the urine; while in others it was "borne surprisingly well."[2]

Sir William Roberts considers milk much less deleterious to a

[1] Bauer, p. 302.

[2] Bauer, *Dietary of the Sick*, p. 296.

diabetic patient than might have been supposed, but he admits it is better to replace it by cream.

There are, as might be imagined, great practical difficulties in constructing a satisfactory dietary for diabetics exclusively of albuminates and fat; indeed, the quantity of fat necessary to supply the requisite amount of carbon needed in the system is with difficulty appropriated by the organs of digestion, and to attempt to meet the demand for carbon by albuminates alone would necessitate an altogether unmanageable quantity of such foods.

We are, then, in the end driven to adopt a *mixed* diet, the different articles of which have to be selected with especial regard to the amount of sugar-forming material they contain, choosing of course those which contain the minimum, and always looking to the albuminates and fats as the chief nutritive elements of the dietary.

First, with regard to bread. This forms so important an article in the habitual daily dietary of the healthy, and the ordinary kinds of bread are so rich in carbohydrates, that the ingenuity of physicians has been greatly taxed to produce a bread for the diabetic which shall prove a satisfactory substitute for ordinary bread.

Bouchardát suggested gluten bread as a suitable food for the diabetic; this is a bread made of wheat flour deprived by repeated washings of as much of its starch as possible.

But gluten bread is never entirely free from starch, and, unless it is prepared with great care and by reliable manufacturers, may even contain a considerable quantity of this substance. It is also by no means agreeable to the palate. Yet when well and carefully prepared it undoubtedly supplies a need.

Bran bread, introduced by Prout, made from bran washed as free from starch as possible, has also been largely used for diabetics; but, unless very carefully prepared, it contains a considerable amount of starchy material, and also a large proportion of indigestible cellulose, which with some persons sets up a great deal of gastro-intestinal irritation.

Pavy introduced almond cakes as a substitute for ordinary bread, and they are undoubtedly valuable. By washing the meal of sweet almonds with acidulated water the greater part of the sugar is removed, and the meal so treated may be made by careful preparation into a palatable cake or biscuit.

Seegen has also advocated the use of almond cakes, but they are not popular with the French authorities. Germain Sée prefers a small quantity of ordinary bread—5 ounces daily—or the same quantity of potato-meal.

Dujardin-Beaumetz also objects both to gluten bread and to almond cakes; the former, he maintains, is often found to contain a consider-

able percentage of starch, and he warmly advocates the use of potatoes instead for those diabetics who cannot do without some food of this kind. Potatoes cooked in the oven contain, he asserts, only 8.3 per cent. of sugar-forming material, while gluten bread contains 27 per cent. These figures, of course, apply only to the gluten bread prepared in Paris. We must also remember that potatoes have no claim to be considered as giving any approach to gluten bread in nourishing properties, as they contain only 2.8 per cent. of albuminates.

Sago bread, recommended by Dujardin-Beaumetz, has proved very distasteful to the diabetic patients who have tried it at our suggestion.

All kinds of animal flesh and fats; all kinds of meat, fresh and preserved, provided that sugar has not been used in their preservation, are permitted—ham, bacon, sausages, fowl, game, fish, fresh and smoked, crustacea (crabs, lobster, etc.), oysters; eggs, cheese, butter, cream, and all animal fats and oils—cod-liver oil, and olive oil.

In cooking any of these—as fish—it must be remembered that flour or other starchy material cannot be used, nor in the preparation of sauces; and when "melted butter" is used as a sauce it must not be thickened by flour.

As one great object in the diet of the diabetic is to supply the deficiency of carbon—owing to the exclusion of the ordinary carbohydrates—by an increased consumption of fats, we may make free use of such articles of diet as *pâté de foie gras*, sardines in oil, *thon* in oil, *filets d'hareng saure à la Norvégienne;* and Dujardin-Beaumetz extols the use of caviare: it excites appetite, and he states that he has had patients in the last stage of diabetes who owed their survival to the use of caviare.

Green and fresh vegetables are freely allowed, and should enter as much as possible into the dietary of the diabetic—such as cabbage, spinach, sorrel, lettuce, dandelion, cucumber, water-cresses, and those vegetables commonly used for salads. Some physicians allow a small quantity of such vegetables as green French beans, asparagus, celery, onions, leeks, and even carrots and truffles. Carrots, turnips, beans, peas, and beet-root are, however, commonly prohibited.

Fruits are altogether prohibited by some, and not by others. All agree in forbidding the sweeter kinds of fruits and all candied and preserved fruits. Many authorities, on the other hand, consider a moderate amount of fresh acidulous fruit permissible—gooseberries, apples, currants, cherries, etc., as they contain more levulose than grape-sugar.

All vegetables and fruits containing large amounts of starch and sugar must be strictly forbidden.

The question of beverage is a very serious one to the diabetic, for his

thirst is, as a rule, urgent and constant, and his temptation to drink when and what he ought not to drink is very great.

All strong alcoholic and saccharine drinks must be forbidden, except in very small quantities and largely diluted with water or an alkaline mineral water.

A small quantity of the lighter acid wines, such as claret, hock, and still Moselle, may be allowed, mixed with water. Unsweetened spirits —brandy, gin, and whiskey, mixed with water—may occasionally be substituted for wine.

Weak infusions of tea and coffee or cocoa, made without sugar, are admissible; these may be sweetened if necessary with minute quantities of saccharin (not more than $1\frac{1}{2}$ grains of this substance should be taken daily, as gastric pains and disorder have been provoked by its constant use in larger doses).

As to wines, it is desirable to state which kinds (of those generally permitted) are best borne by different diabetics.

All saccharine wines (ports, champagnes, Sauternes, etc.), liqueurs and beer must be strictly avoided.

Finally, in dieting diabetic patients we must adapt our rules to individual cases, and carefully observe whether the *régime* we advise is well borne by different patients. We should, therefore, frequently examine our patients' urine, and notice what influence is exercised on the amount of sugar excreted by different articles of food; we should also weigh our patients frequently to ascertain the effect of the dietary which has been adopted on the nutrition of the body.

If we follow this plan, we shall discover that some diabetics may be permitted a much more liberal and varied dietary than others, and that measures which on theoretical grounds might appear necessary, often prove practically undesirable.

As examples of diabetic dietaries we subjoin the following:

SEEGEN'S.

Sanctioned.	*Forbidden.*
In any quantity:	Farinaceous foods of all kinds.
Flesh of all kinds; preserved (smoked) meats, ham.	(*Bread only in very small quantity, according to the discretion of the physician.*)
Tongue, bacon.	Sugar.
Fish of all kinds.	Potatoes, rice, tapioca.
Oysters and shell-fish.	Arrowroot, sago, groats.
Crabs, lobsters.	Peas, beans.
Animal jellies.	Sweet fruits, as grapes, cherries, peaches, apricots, plums, and all kinds of dried fruits.
Eggs, caviare, cream, butter, cheese.	
Spinach, cooked salads, endive.	
Cucumber, green asparagus.	
Water-cress, sorrel.	
Artichokes, mushrooms.	
Nuts.	

In small quantity:

Cauliflower, carrots.
Turnip, white cabbage.
Green beans.
Berries, such as strawberries, raspberries, currants; also oranges and almonds.

BEVERAGES.

Sanctioned.

In any quantity:

Water, soda-water.
Tea, coffee.
Bordeaux, Rhine, and Moselle wines.
Austrian and Hungarian table wines; in short, all wines that are not sweet, and that contain only a moderate amount of alcohol.

In very small quantities:

Milk, unsweetened.
Almond emulsion.
Brandy, bitter beer.
Lemonade, unsweetened.

Forbidden.

Champagne and sweet wines and beers, fruit-wines and fruit-juices and syrups.
Sweet lemonade.
Liqueurs.
Ice and sorbets.
Cocoa and chocolate.

SIR WILLIAM ROBERTS'.

Sanctioned.

Butchers' meat.
Poultry and game.
Fish.
Cheese.
Eggs.
Butter, fat, and oil.
Broths, soups, and jellies, made without meal or sugar.
Cabbage, endive, spinach.
Broccoli, Brussels sprouts.
Lettuce, spring onions.
Watercress, mustard and cress.
Celery.

Substitutes for bread:

Bran cake, gluten bread (and meal), almond meal, rusks, and biscuits.
"Torrefied" or charred bread.

Forbidden.

All saccharine and farinaceous foods.
Bread, potatoes.
Rice, tapioca, sago, arrowroot, macaroni, etc.
Turnips, carrots, parsnips, beans, and peas.
Liver (contains much sugar-forming substance), and therefore
Oysters, Cockles, Mussels, } containing enormous livers.
The "pudding" of crabs and lobsters.
All sweet fruits, as apples, pears, plums, gooseberries, currants, grapes, oranges, etc.

BEVERAGES.

Dry sherry, claret, bitter ale.
Brandy and whiskey (in small quantities).
Tea, coffee (no sugar), chocolate (made with gluten meal), soda-water, bitartrate of potassium water.

Port and all sweet wines.
Sweet ales and porter.
Rum and sweetened gin.

EBSTEIN'S.

He maintains that every case should be individualized. The food

he prescribes depends on the age and individuality of the patient. For thin persons he prescribes more fat than for corpulent ones.

EARLY BREAKFAST.

One cup of coffee or tea (black), without milk and sugar.
White bread toasted, 1 to 2 ounces; or brown bread, well buttered—butter ½ to 1 ounce.
The yelk of an egg, a little fat ham, or some German sausage (if required).
If any food be needed between this meal and dinner, let it be a cup of broth, with the yelk of an egg.

DINNER.

Broth, with yelk of egg or marrow (the marrow-bone is boiled for half an hour, to solidify the marrow). Some pepsin may be added to the broth.
Meat (2 to 8 ounces, free from bone), roasted, boiled, or stewed—beef, mutton, pork, veal, fowl, or venison (fat meat preferred).
Gravies, with cream or yelk of egg, *not* flour.
Or fish, with melted butter.
Vegetables, prepared with much fat; *purées* of leguminous plants. *Salads*, dressed with vinegar and oil, and some cream.
The food should be well salted and spiced.
After dinner, a cup of coffee or tea.

SUPPER.

One cup of tea or broth.
Meat roasted, ham or cheese, or an egg, or fish, caviare.
Bread, 1 to 2 ounces, with butter, ½ to 1 ounce.
Apples, pears, and stewed fruit are allowed in small quantities.
Beverages.—He forbids absolutely the use of beer, limits the use of spirits, and allows about half a bottle of wine daily.
If the patient digests milk well, he allows it in moderate doses, and cream is regarded as particularly useful.

Food in Albuminuria.—Albumin appears in the urine under a variety of circumstances. We are now only concerned with those instances in which appropriate dietetic treatment is called for, and of these the cases of so-called chronic Bright's disease are by far the most important.

The question whether a diet rich in albumin or an excess of albuminous ingesta can give rise to albuminuria has been investigated experimentally by many observers, with somewhat conflicting results.

It is generally admitted that when albuminuria exists, certain kinds of food will often cause a great increase in the quantity of albumin excreted in the urine; but it is by no means so generally allowed that a temporary albuminuria can be produced by food in the same way as temporary glycosuria can be brought about.

It has been stated that cheese, pastry, and eggs will induce albuminuria in certain persons, but this is certainly a rare idiosyncrasy. Stockvis and some others have stated that in animals and in themselves they have found that when egg-albumin (uncooked) was taken into the stomach in large quantity a portion of it was excreted in the urine.

Stockvis suggested as an explanation of this fact that a portion of the uncoagulated albumin entered the blood unaltered, and was therefore eliminated as unassimilable. Nussbaum, Coats, and D'Arcy Power claim to have seen albuminuria produced in the same way. Lauder Brunton, however, failed to produce albuminuria by swallowing six raw eggs in succession, and Dr. Macguire swallowed the whites of twelve raw eggs without producing albuminuria. Another observer[1] ate nineteen raw eggs in thirty-six hours without producing albuminuria.

The occurrence of temporary albuminuria from taking large quantities of egg-albumin, raw or cooked, has been explained by the suggestion that the blood, becoming surcharged with albumin, some of the excess escapes by the kidneys; but may not the true explanation be that the ingestion of so large an excess of albuminous material may throw upon the kidney such an excess of nitrogenous waste, in the form of urea, to be excreted, that a temporary functional hyperæmia of the kidneys is excited, and that this leads to a slight escape of albumin from the blood? It appears to me that this is a sound physiological explanation of what is observed, and accounts for its occurrence in feeble or disordered constitutions, and its absence in the perfectly sound and vigorous.

Dr. Grainger Stewart also tested the effects of some other articles of food, as cheese and walnuts, and came to the conclusion that, although "particular articles of diet induce albuminuria in some people, yet the quantity of albumin is usually minute, and it has little tendency to persist after the resumption of ordinary food."

Pettenkofer and Voit's observations[2] convinced these physiologists that albuminuria was never caused solely by excess of nitrogenous food. Voit gave a dog weighing 35 kilogrammes 2600 grammes of meat in twenty-four hours, and found not the least trace of albumin in the urine; yet the animal had absorbed nearly six times the amount of dry albumin contained in the fluids of its body.

Professor Oertel has also experimented on the effects of the ingestion of egg-albumin. He gave to his dog, weighing only $7\frac{1}{2}$ kilogrammes, the whites of twenty eggs in twenty-four hours by the stomach, and after various trials he never found albumin in the urine. He also gave to one of his patients affected with heart disease, besides 350 grammes (about $12\frac{1}{2}$ ounces) of meat, 190 grammes (about 7 ounces) of bread and 200 grammes (rather more than 7 ounces) of vegetables; *six raw eggs daily for twelve days—i. e.* seventy-two eggs altogether—containing 460 grammes of dry albumin, without finding a trace of albumin in his urine. He obtained, moreover, the same negative result with a patient who ate, on an average, six boiled eggs daily.

[1] Dr. Dobradin, quoted by Grainger Stewart.

[2] Quoted by G. Sée, *Du Régime alimentaire*, p. 705.

It is, then, I think, safe to conclude that the occasionally observed occurrence of albuminuria as a result of the ingestion of albuminous food in excess is an accidental peculiarity or idiosyncrasy, and not an ordinary physiological phenomenon.

With regard, however, to diet in albuminuria when connected with existing renal disease, there is, as I have already said, an almost general consent that richly-nitrogenized food is distinctly prejudicial, and more especially so if it consists of brown meats, of eggs, or of highly-spiced food.

Grainger Stewart has, nevertheless, expressed his belief that in the cirrhotic form of Bright's disease diet is a less important element of treatment than in cases of tubular inflammation; and he gives the particulars of cases in which he ordered eight raw eggs daily in addition to the usual "low diet," without causing any material change in the secretion.[1]

But, as Dujardin-Beaumetz has well pointed out, in dealing with cases of advanced Bright's disease it is not so much the quantity of albumin that appears in the urine that should be our chief concern, but rather the extent of the renal changes and the *consequent retention* of products of nitrogenous waste in the system; and it is to avoid or diminish the risks of this *intoxication* with urinary excreta that our dietetic rules should be directed.[2]

The clear indication, then, is to administer such food as is found to be readily assimilable, and which will tax least the digestive functions, and at the same time furnish the smallest amount of nitrogenous waste calling for elimination by the damaged kidneys.

To fulfil this indication it has been proposed to restrict the food of those suffering from both acute and chronic Bright's disease exclusively or almost exclusively to milk; and it is certain that some of the most remarkable and best results in the treatment of these cases have been obtained from a strict adherence to milk diet. In cases in which this plan of feeding has been well borne it has been observed that the flow of urine has increased, the excretion of albumin diminished, the amount of urea and extractives has been augmented, and the anasarca has disappeared.

But great practical difficulties are often encountered in procuring the adoption of this method by the patients themselves, and in not a few cases a diet consisting exclusively, or even largely, of milk is not well tolerated.

It has been calculated that from 5 to 7 pints of milk daily will be sufficient for all the food-requirements of an adult.

An exclusively milk diet is thus administered:

If the patient's stomach will bear the sudden suppression of all

[1] *Op. cit.*, p. 206.

[2] *L'Hygiène alimentaire*, p. 188.

other kinds of food, the full quantity of milk may be at once taken daily; but if the stomach shows less tolerance of the change, it should be made more gradually, and half a glass or a glass of milk should be taken at suitable intervals, and the other kinds of food slowly and by degrees replaced by it.

The milk should be as fresh from the cow as it is possible to obtain it, and drunk at the ordinary temperature, not boiled and with no flavoring or addition whatever. It is better to take it in small or moderate quantities at short intervals—a glass (6 ounces) every hour during the day, and two glasses on getting up and on going to bed; or when it is inconvenient to take it so often, two glasses may be taken every two hours. When the patient is restricted entirely to milk, it must be remembered that he will require to take from twelve to twenty-four glasses of 6 ounces each in the twenty-four hours.

The occurrence of diarrhœa indicates that the milk is not digested, and then the diet should be altered or modified. If, together with obstinate constipation, an unpleasant taste in the mouth and a dirty tongue appear, the state of the mouth may be improved by sipping a little soda- or seltzer-water after each glass of milk; and the constipation must be relieved by some suitable aperient—a little Gregory's powder, or compound liquorice powder, or citrate of magnesium, or a capsule of castor-oil, or a teaspoonful of Carlsbad salts or an aperient enema.

The body-weight usually diminishes somewhat during this treatment; the urinary secretion is often increased to a remarkable extent, and this diuresis is generally accompanied by a disappearance of dropsy, if it exists.

The abundant urine is pale, clear, with a peculiar greenish-yellow reflection, said to be characteristic of the milk diet; it is usually of low specific gravity, on account of the quantity excreted, and of diminished acidity; the amount of albumin excreted will usually be observed to diminish gradually from day to day, while the proportion of urea and salts is progressively increased.

The period during which the treatment should be maintained cannot be fixed with any strictness. It must depend upon the nature of the case and the progress of the patient.

If we are treating a case of acute nephritis, and have adopted the exclusively milk diet from the commencement, three or four weeks may suffice to get rid of the albuminuria, and we may slowly and gradually return to the ordinary diet.

In chronic parenchymatous nephritis (inflammation of the tubules) the result of treatment will depend upon the age of the patient and the duration and extent of the kidney lesions.

In advanced cases, in which cure is not possible, considerable amelio-

ration in the general condition of the patient may constantly be observed, together with an increased flow of urine, disappearance of dropsy, a steady diminution, little by little, of the amount of albumin, and, although it may not entirely disappear, at the end of six or eight weeks it will be reduced to a minimum. The kidney lesions are irreparable, but the milk diet has lessened, in a great measure, the excretion of albumin, and has restored a proper elimination of the nitrogenous and other urinary excreta.

In cases of cirrhotic or interstitial nephritis (gouty contracted kidney) an exclusively milk diet is less urgently indicated. When, however, the cardiac compensation begins to fail and symptoms of uræmia are threatening, then great advantage may follow the adoption of this mode of treatment.

We are in ignorance at present as to the precise manner in which the milk acts on the organism or on the diseased kidneys so as to produce the beneficial results observed.

In those cases in which an exclusively milk diet is badly borne or absolutely rejected by the patient we must fall back on some other method of feeding.

We should, in the first place, endeavor to induce the patient to accept a modified milk diet, and supply him with dishes largely composed of milk, but which have the advantage of some agreeable flavoring, without which foods of all kinds are repugnant to many.

Milk may be made the basis of soups, to which various vegetable flavoring substances may be added, as onions, celery, and the usual aromatic herbs commonly employed for such purposes, together with a little salt and pepper; fragments of toasted bread may be served with these milk soups. Arrowroot, tapioca, rice, and vermicelli may be used to thicken milk, and a little grated lemon-peel or cloves or nutmeg may be used to flavor foods thus made, or a small quantity of fruit-jelly, such as red-currant jelly, may be eaten therewith.

On leaving off the exclusively milk diet the patient should be permitted, by slow degrees only, to return to the ordinary diet.

At first a little arrowroot, tapioca, or rice should be substituted for a portion of the milk; then a little fish, chicken, or other white meat, and a little green vegetable, or cooked fruit, and a small quantity of good sound Bordeaux wine, mixed with seltzer-water, may be taken with the midday meal.

Should the attempt to return to a mixed diet be attended with an increase in the quantity of albumin excreted, the exclusively milk diet must again be resorted to.

It must, of course, be borne in mind that an irreparably damaged kidney cannot be made structurally sound by milk diet or by any other remedy; and in such cases, after the albumin has been reduced to a

minimum by the milk diet, a return to a carefully-arranged mixed diet may not only be justifiable, but advantageous.

Oertel, Grainger Stewart, and others have shown that in many such cases a diet rich in albumin is well tolerated, and not attended with any notable increase in the amount of albumin excreted in the urine.

It is in acute cases, and especially in those cases which seem to be passing from acute to chronic, and before the structure of the kidneys has been hopelessly damaged by inflammatory and degenerative changes, that the exclusively milk diet is attended with such brilliant results.

In those cases in which, for some reason or other, the milk diet is inadmissible, we have to consider what is the best alternative.

It has already been pointed out that the subjects of albuminuria must carefully avoid any excess of nitrogenous food. Senator recommends that animal food should be altogether avoided, or limited to, at most, a little white meat, while all kinds of vegetables and fats are permissible. Dujardin-Beaumetz also testifies that he has obtained excellent results by restricting patients with albuminuria to vegetable food. Farinaceous food, fresh vegetables and fruit, together with milk, butter, cream, and other fats, afford all that can be needed for the nutrition of the body.

Dujardin-Beaumetz commends the onion, especially, as an addition to soups; and he states that when he has found his albuminuric patients unwilling to relinquish meat, pork has appeared to him to increase the amount of albumin excreted less than other meats, and he is therefore in the habit of recommending to them either ham or cold roast pork, and the fat in particular. He differs from Senator in not thinking well of fish in these cases; he believes it notably increases the amount of albumin in the urine. As cheese is a highly albuminous food, it should be avoided altogether or taken only in very small quantity.

As a beverage he prefers milk, so long as the patient can tolerate it; all spirits and undiluted wines and all kinds of beer he forbids entirely.

Food in Gout and Uricæmia.—Chiefly by the labors of Garrod three facts have been established with certainty in connection with gout: 1st, that in the gouty there is an excess of uric acid in the blood; 2d, that during an attack of gout there is a diminution of uric acid in the urine, often by one half; and 3d, that at the end of an attack there is an excess of uric acid in the urine. And these facts are interpreted as meaning that before, and especially during, an attack the blood is surcharged with uric acid, and that at the end of the paroxysm this excess is discharged in the urine, and the patient is, for a time at any rate, free from his uricæmia.

But although it is generally admitted that in gout there is an excess of uric acid in the blood, it is not certain whether this is due to an abnormally large *production* of uric acid in the body or simply to its abnormal *retention.*

The deposition of uric acid in the bodies of the gouty may be simply dependent on a diminished power on the part of their fluids to hold the salts of uric acid in solution ; and this inability to hold the uric-acid salts in solution may depend on an abnormally acid state, or, what is the same thing, a diminished alkalinity of those fluids.

It was held, and is still held by many, that uric acid represents a low grade of oxidation of the nitrogenous waste necessarily produced in the metabolism of albuminous foods, and that when such foods are taken in great excess they cannot be completely oxidized into urea, which is very soluble and readily eliminated, and that, consequently, an abnormally large proportion is converted into uric acid, representing a lower grade of oxidation ; and the salts of this acid being very insoluble, are less readily eliminated , and therefore tend to accumulate in the blood and to be deposited in the body.

This view of course traces gout to an excess of nitrogenous ingesta. But if we refer gout to a deficient alkalinity and diminished solvent power of the fluids, however brought about, we get a wider, and perhaps a truer, grasp of the causation of the disease ; for while this view recognizes the causative influence of an excess of albuminates in the food, it does not exclude other causes, which we must take into consideration in explaining the occurrence of this disease in many persons.

It has been noticed (Voit and Hoffmann) that strongly acid urines show a tendency to deposit sediments, and it has been pointed out that in the metabolism of albumin the sulphur and phosphorus contained in it become converted into sulphuric and phosphoric acids, all of which may not be completely neutralized, and may be sufficiently in excess to augment the acidity of the urine ; so that an excess of albuminous food may contribute to the deposition of insoluble salts of the uric acid by diminishing the alkalinity of the fluids ; which, indeed, it is known to do. In the same way, those dyspeptic conditions which are so common in some gouty persons who are not large feeders may tend to an increased formation of the organic acids, and so to a reduction in the alkalinity of the blood, and thus bring about *uricæmia—i. e.* a retention of uric acid in the blood.

Thus we already see that one of the most important dietetic indications in the treatment of the gouty is to maintain the normal alkalinity of the fluids and to maintain or augment their solvent power ; and precisely the same indication with regard to food applies to the tendency to the formation of uric-acid gravel and calculi.

As I have already pointed out, it is a well-established fact that a

highly nitrogenized animal dietary increases the acidity of the fluids of the body, and especially of the urine; and it is equally well known that a vegetable dietary increases the alkalinity.

One of our chief objects, therefore, in constructing a dietary for the gouty is to diminish, within suitable limits, the amount of animal food they consume, and to replace it with an equivalent quantity of appropriate vegetable substances.

The extent to which this can be carried with safety will depend upon the habits of life, the occupation, and the digestive peculiarities as they are met with in individual cases.

For the indolent and sedentary animal food should be reduced to a minimum; to the energetic and active a more liberal proportion may be allowed. But in all cases we must, above all things, avoid exciting dyspeptic states by an unwise stringency of dietetic rules ill adapted to the digestive peculiarities which many of these patients present.

Great moderation in the consumption of animal food is, then, one of the first rules for the gouty.

It is also the experience of the majority of authorities that in the food of the gouty *fats* as well as albuminates should be reduced to the minimum; fatty, saccharine, and gelatinous foods, by interfering with the complete metabolism of the albuminates, tend to the production of uricæmia. Bauer points out that we ought not only to restrict the amount of fat in the food, but that, as corpulent persons perspire freely, and therefore, as a rule, secrete a concentrated urine liable to yield deposits, we should also adopt other means to prevent the accumulation of fat.

Germain Sée insists especially on the prejudicial effects upon the gouty of a diet rich in nitrogenous food when combined with sugar, gelatin, and fats.

Ebstein, however, advocates the consumption of a moderate amount of fat, so as to diminish the quantity of carbohydrates needed, as he regards these as the most fattening of all foods. He also considers fat useful as quickly satisfying the appetite and diminishing the desire for food.

We see no reason for withholding a moderate amount of fatty foods from gouty persons who show signs of defective nutrition, provided they digest them without difficulty; but, on the other hand, we should restrict them as much as possible in the diet of the corpulent and well-nourished.

It is a grave error to impose on the gouty a too rigorous abstinence. Their diet must contain all that is needed for the due nutrition of the body and for maintaining its functional activity. It must therefore be proportioned, in some measure, to the work and activities of individual organisms; but it is a wise precaution at all times to draw the sup-

plies of food, so far as practicable, from the more readily digested and more nutritious vegetables.

Green vegetables and fresh fruits are especially suitable, as they are known to render the urine more alkaline, while they do not favor the deposit of fat in the body; but an exclusively vegetable diet is by no means to be commended, save in quite exceptional instances.

The feeble digestion of many gouty persons is quite unequal to appropriating that comparatively large mass of vegetable food which is necessary to supply the wants of the system, and a certain proportion of more concentrated and easily-digested animal food is therefore necessary for them.

White are generally considered more appropriate than *brown* meats, and, bulk for bulk, this may be true. But there is no proof that small quantities of well-cooked and tender mutton or beef are more prejudicial to the gouty than larger quantities of chicken and rabbit; indeed, the latter, although a white meat, has often appeared to us more difficult of digestion than beef and mutton.

There is a general consent that smoked and dried or pickled pork, game, fish, and other meats should be proscribed, as they all present very condensed forms of nitrogenous food, and excite thirst, which is not always quenched with pure water. Rich and fat sauces should be altogether avoided, and all *entrées* and made dishes which are served with sauce. Strong meat-soups and extracts are also particularly undesirable; and when soups are taken they should be vegetable soups, only slightly flavored with animal extract. One teaspoonful of Valentin's meat-juice added to half a pint of a purely vegetable soup imparts quite as much of this flavor as need be desired.

Cheese, as one of the most concentrated forms of nitrogenous food and as often difficult of digestion, should be avoided.

As the yelk of egg contains a large amount of fat and lecithin, eggs should enter as little as possible into the dietary of the gouty.

Fish, oysters, and the crustaceæ (crabs and lobsters) must be partaken of sparingly; the rich and firmer fish, such as salmon, mullet, mackerel (and perhaps lobster and crab), had better be altogether avoided.

An almost unlimited choice of fresh vegetable food may be permitted—potatoes and the ordinary green vegetables and salads. Sorrel, tomatoes, and asparagus have, however, been especially prohibited, on the ground that they contain oxalates, and oxalic acid is a congener of uric acid. But we have been recently assured that it is an error to proscribe tomatoes, as they contain but a very small amount of oxalic acid, whereas spinach, which has been so universally approved of, is, next to sorrel, the richest in this acid.[1] Asparagus, if eaten without melted butter, we see no practical objection to.

[1] Dujardin-Beaumetz, *L'Hygiène alimentaire*, p. 169.

Those dry vegetables which are both rich in albuminates as well as in carbohydrates, such as haricot and other beans, peas, and lentils, should be partaken of only in small quantity. Mushrooms and truffles are prohibited.

Bread, which is also a highly nitrogenous food, should be taken only in moderation, and is perhaps least harmful when well toasted. Bouchardat has proposed to substitute potatoes for it.

Most fresh, ripe fruits are wholesome, and most cooked fruits, as stewed or roasted apples, etc.; but the highly saccharine fruits, whether fresh or dry, are not so suitable, and should be taken in very moderate quantities.

As to the best beverages for the gouty, and first as to milk: some differences of opinion exist with regard to milk, and no doubt there are great individual peculiarities in respect of its digestibility. Some cannot digest it at all, some dislike it excessively, and others can digest it in any quantity and are fond of it. For the latter we consider that it serves as an admirable form of food, especially if skimmed or diluted, presenting, as it does, all the principles necessary for the nutrition of the body in a form readily assimilated by those with whom it agrees, and containing a large quantity of water. It is an advantage to render it slightly alkaline by adding to it a little alkaline water, such as Vals or Vichy water, when it often acts freely as a diuretic. Indeed, we are in the habit of advising our gouty patients and those who have shown any tendency to the deposition of uric-acid gravel to drink, about ten minutes before their first meal, a breakfast-cupful of hot milk and water to which a small level salt-spoonful of bicarbonate of potassium and the same quantity of table salt should be added. In this form, well diluted and rendered distinctly alkaline, we can see no objection to the use of milk.

Ebstein has maintained, and Germain Sée also, that of those who deposit uric-acid gravel, there are some whose urines do not contain an excess of uric acid, but that this acid is deposited simply because these urines are not in a condition to hold it in solution: either they do not contain enough water or they may contain an excess of acid phosphates, which combine with the soda needed to hold the uric acid in solution; it thus becomes free, insoluble, and deposited in the crystalline form. In such instances the value of an abundance of slightly alkaline watery beverages is very obvious. A draught of hot water half an hour before a meal or at bedtime, and the use of the alkaline table-waters to mix with wine or whatever stimulant is taken, should be recommended. The habit of drinking, in some form or other, a considerable quantity of water is an important point in the dietary of the gouty; and whatever wine or spirit they take should be largely diluted, either with pure water or with an alkaline effervescing

table-water. The value of drinking considerable quantities of hot water has been largely insisted on by many physicians, and we have had occasion to form a favorable opinion of the practice if kept within certain limits.

Strong beers, porter, and stout should be avoided by all gouty persons. We have known a few instances in which stout has been well borne, but a large quantity of alkaline salts were at the same time taken habitually.

Of wines, those which are strong, sweet, or spirituous should be carefully avoided, such as sweet or strong champagnes, ports, sherries, Madeira, Burgundy, and the stronger clarets. All wines which contain much sugar, alcohol, tannin, or free acid are unsuited to the gouty. Still Moselle, light hock, some of the best Hungarian wines, light, well-kept, fine-quality Bordeaux,—all these are permissible in small quantity, diluted with an alkaline table-water, so as to neutralize any free acid they may contain. The more distinctly diuretic the effect of the wine, the better, as a rule, will it agree with the gouty.

With regard to alcoholic beverages in general, it may be said, unhesitatingly, that the gouty persons who can do without them entirely are wise to do so. If they cannot exist comfortably without a small or moderate amount of alcoholic beverage, then they must exercise great care in its selection. There is all the difference in the world between the effects of a fine, mature, high-quality wine or spirit and the commoner kinds of the very same beverages. They should always be well diluted. Of spirits, the best are fine old Scotch whiskey, dry Plymouth gin, and the finer kinds of French cognac, when they can be obtained.

Both tea and coffee, when not strong, are exceedingly useful beverages to the gouty, unless they are found to disturb the digestion, which they will do with some persons. In that case it is necessary to take them without sugar. It is the quantity of sugar so commonly taken with these beverages that helps to make them injurious.

The best China tea, and not Indian tea, should be employed for infusion, as the latter contains far too much tannin.

Food in Obesity.—In a very large proportion, if not in all, of the cases of excessive corpulence a reduction in the *quantity* of food taken is the essential condition of its cure ; and that reduction must be sufficient to remove all excess of fat-forming food (and there is scarcely any form of food from which fat cannot be formed) from the dietary. Let us bear the fact in mind, in dealing with cases of obesity, that a patient weighing one hundred and sixty pounds may add fifty pounds to his weight in five years simply by the daily deposition within his body of half an ounce of fat derived from this small daily excess of fat-producing food.

The most common cause of obesity is the excess of food, although in some cases it may be difficult at first to discover in what particular there is excess; for we must also recognize a peculiar constitutional, and often inherited, aptitude for fattening—observed also in many animals—which leads to the development of obesity from an almost inappreciable excess of food or drink.

There is also another important preliminary consideration to be kept in view, and that is that different obese persons may, and probably do, possess different faculties for the conversion of different kinds of food into fat, so that one person may derive his excess of fat from one class of food, and another from another class; and therefore that the remedial measures appropriate and successful in some cases may not be those best calculated to lead to a successful result in others. Each case of obesity, therefore, must be made the subject of individual study and analysis, although certain general principles are probably applicable to the great majority.

The frequent occurrence of obesity about and after middle age points also to another very important consideration—viz. that the need of food naturally diminishes with advancing years, just as the capacities for digestion and assimilation and duly utilizing food also diminish. Ignorance or insufficient recognition of this fact is the chief reason why it is so difficult to deal successfully with many of these cases. It is difficult to make a man of forty years understand that he cannot properly utilize and adequately dispose of as much food as he did when thirty, or a man of fifty as much as when he was forty; so that a diet which would not be in any way excessive at the former age becomes distinctly excessive and provocative of undesirable corpulence at the latter. Even some physicians have overlooked this important point in estimating the average diet needed by corpulent persons at and beyond middle age. It is an error to apply the ordinary average ration, especially to persons of sedentary habits and occupation, at approaching or beyond middle age. With advancing age there should be a diminution in the average amount of food taken.

It cannot be too clearly understood that it is to the neglect of this consideration that so many instances of undue corpulency are attributable in advancing life. The capacity for muscular exertion is also lessened, and there is no longer either the disposition or the ability to engage in those active physical exercises which in earlier years dispose of much of the surplus food-supply.

There are, however, a certain small or moderate proportion of cases of obesity which appear to arise independently of any excess of food, and to be determined by some morbid state of the system leading to defective oxidation and imperfect combustion of certain elements of the

food within the body. To this class must be referred some of the "fat anæmics" alluded to by Dr. S. Weir Mitchell, the cases of obesity associated occasionally with the hysterical state and with nervous disorders, as well as the gravest cases of all—viz. those cases in which fatty degeneration of the nitrogenous tissues accompanies the excessive deposition of fat. These cases must of course be carefully differentiated from the ordinary common form of obesity, and their treatment must be determined by other considerations.

Allusion has already been made to the association, in some rare cases, of anæmia with obesity. This is somewhat difficult of explanation, but we believe it will be found, as we have already suggested, that even in these cases some fault of diet often lies at the root of the condition. S. Weir Mitchell points out that the hysterical constitution, when associated with indisposition to exertion and prolonged rest, together with the morphine habit, "make up a group of conditions highly favorable to increase of fat."

Many systems have been devised for the cure of obesity, and more or less success has been claimed for each of them. We shall pass briefly in review the chief of these, and point out what we consider to be their respective merits and defects.

One of the first to call attention to the importance in these cases of diminishing the amount of water taken or of foods containing water was Dancel, a French military doctor, who had been struck by the remarkable influence that water and watery foods had in causing great abdominal development in horses. His method of reducing obesity was to prescribe as *dry* a diet as possible. The food taken should contain very little water, and very little drink should be taken at any time. Soups and fluid foods were forbidden. Not more than from six to twelve ounces of fluid was allowed at each meal. Abstinence from fatty and farinaceous foods was also enforced, frequent purges were enjoined and much exercise on foot.

This system rigorously carried out was in many instances attended with remarkably good results.

The Banting method, so widely adopted in England at one time, agreed to some extent with the preceding in the strict limitation of the amount of fluid taken and the exclusion of farinaceous foods as well as sugar and fats. But in the Banting diet the quantity of food of every kind was strictly limited, as follows:

Breakfast, at 9 A. M., consisted of 5 to 6 oz. of animal food—meat or boiled fish (except pork or veal); a little biscuit or 1 oz. of dry toast; 6 to 7 oz. of solids in all. A large cup of tea or coffee (without milk or sugar) = 9 oz. of liquid.

Dinner, at 2 P. M.—Fish or meat (avoiding salmon, eels, herrings, pork, and veal), 5 to 6 oz.; any kind of poultry or game. Any vegetables, except potato, parsnips, beet-root, turnips, or carrot. Dry toast, 1 oz. Cooked

fruit, unsweetened. Good claret, sherry, or Madeira, 10 oz. Total of solids, 10 to 12 oz.

Tea, 6 P. M.—Cooked fruit, 2 to 3 oz., a rusk or two; 2 to 4 oz. of solids. 9 oz. of tea, without milk or sugar.

Supper, 9 P. M.—Meat or fish, as at dinner, 3 to 4 oz. Claret, or sherry and water, 7 oz.

This diet allowed only from 21 to 27 ounces of solids per diem, of which from 13 to 16 ounces consisted of animal food and only 2 ounces of bread; the rest consisted of fruit and fresh vegetables. There was the strictest possible exclusion of starches and sugar. The total fluid was limited to 35 ounces—*i. e.* about a pint and three-quarters.

With this diet Mr. Banting reduced himself in a year from two hundred and two pounds to one hundred and fifty-six pounds.

The Ebstein method, which has been largely applied in Germany, differs from the preceding in recognizing the possible transformation of albuminates into fat; and Ebstein considers that this transformation is chiefly dependent on the simultaneous free use of carbohydrates, but that the consumption of fat has little or no influence in this direction. He recommends the use of fat, because it produces a feeling of satiety or satisfaction, and so leads to the consumption of less food, and also, by diminishing thirst, lessens the desire for fluids. Dujardin-Beaumetz points out that Hippocrates anticipated Ebstein in this matter, and quotes his advice to the obese that they should eat fat, on account of its satisfying effects and its influence in lessening the consumption of food. Ebstein maintains that it is precisely owing to the presence of fat in food that the accumulation of fat in the body is prevented, and he consequently advises all kinds of fatty food—the fat of meat, butter, cream, and fatty sauces and soups; but he rigorously forbids the carbohydrates, such as sugar, potatoes, and all forms of starchy food, and he allows only $3\frac{1}{2}$ ounces of bread per diem. He permits asparagus, spinach, cabbage, peas and beans, and all kinds of meat in small quantity. The following is an example of the Ebstein *régime:*

Breakfast (6 A. M. in summer, 7.30 A. M. in winter).—White bread, well toasted (rather less than 2 oz.), and well covered with butter. Tea, without milk or sugar, 8 or 9 oz.

Dinner, 2 P. M.—Soup made with beef-marrow. Fat meat, with fat sauce, 4 to 5 oz. A moderate quantity of the vegetables mentioned above. Two or three glasses of light white wine. *After the meal*, a large cup of tea without milk or sugar.

Supper, at 7.30 P. M.—An egg, a little roast meat, with fat. About an ounce of bread, well covered with butter. A large cup of tea, without milk or sugar.

It will be observed that this is a very spare dietary, although it contains a considerable proportion of fat.

The large cup of tea three times a day is, no doubt, intended (as well as the fat) to enable the small amount of food to be borne without a feeling of exhaustion.

But the most popular system at present for reducing obesity is that advocated by Oertel, and adopted, with some modification, by Schweninger. It will be desirable, therefore, to describe it in detail.

Oertel claims for his system that it not only provides for the removal of fat, but also prevents its re-accumulation, and at the same time restores tone to the organs of circulation, which so often, in cases of excessive obesity, is lost. He distinguishes two degrees of obesity—one, the slighter form, in which the organs of circulation are unaffected and vigorous bodily exercise is possible; and another, the graver form, in which the muscle of the heart is invaded and weakened, and other functional derangements connected therewith developed.

Adopting Voit's statement that the human body decreases in fat if the daily food consists of the three great groups of food in the following proportions: albuminous food, about $4\frac{1}{2}$ ounces; fatty food, about $1\frac{2}{5}$ ounces; and carbohydrates, about $5\frac{1}{3}$ ounces, the following comparative table shows the relations of the Banting, Ebstein, and Oertel methods to the above theoretical estimate and to one another:

	Albuminates.	Fats.	Carbohydrates.
Banting	6 oz.	$\frac{1}{3}$ oz.	$2\frac{3}{4}$ oz.
Ebstein	$3\frac{1}{2}$ oz.	3 oz.	$1\frac{3}{4}$ oz.
Oertel	$5\frac{1}{2}$ to 6 oz.	1 to $1\frac{1}{4}$ oz.	$2\frac{1}{2}$ to $3\frac{1}{2}$ oz.

They all agree in largely reducing the carbohydrates, so that there is a general consent that these foods greatly contribute to the excessive deposit of fat.

Oertel's formula differs from the Banting formula simply in allowing considerably more fat and slightly more starchy food. It differs greatly from Ebstein's in allowing nearly twice as much albuminous food, less than half as much fat, and about twice as much carbohydrates. This amount of fat and carbohydrates is admissible in those cases in which active exercise can be and is taken, as muscular exertion is attended by a considerable destruction of fat, and the relative excess of albuminous food in this formula leads to the displacement of the fat accumulated in the substance of the muscles, and to a new formation of muscular tissue in its place. At the same time, this diet protects the nitrogenous tissues from waste—a necessary condition of health which is lost sight of in Ebstein's method. Indeed, the central idea in this "cure" is to *strengthen the muscle of the heart;* and this is aimed at, not only by a carefully-considered dietary, but by the prescription of regular, active bodily exercise and suitable gymnastics.

Oertel's cure aims, then, at the following objects:

1. To improve the muscular tone of the heart;
2. To maintain the normal composition of the blood;

3. To regulate the quantity of fluid in the body; and

4. To prevent the deposit of fat.

And these objects are attained by the following means:

1. The muscle of the heart is strengthened by enforced exercise—by walking or, better, by climbing heights. The patient should walk slowly up hill until palpitation comes on, when he must stop until he can again breathe easily, but he must not sit down. He must walk several hours a day and climb as much as possible. He should go up stairs now and then by way of exercise. Of course the capacity for taking exercise will be found to differ in different cases. Too much must not be required, but also not too little.

2. To preserve the normal composition of the blood the food should be chiefly albuminous. It may consist of the lean of roast or boiled beef, veal, mutton, game, and eggs. Green vegetables, such as cabbage and spinach, may be taken; fat and carbohydrates only in very limited quantities; and from 4 to 6 ounces of bread per diem.

3. To regulate the quantity of fluid in the body, the amount of fluid drunk daily must be limited. One cup (rather less than 6 ounces) of coffee, tea, or milk, morning and evening, and about 12 ounces of wine, with from 8 to 16 ounces of water, should comprise all the fluid consumed in twenty-four hours. In the hot season the amount of fluid may be slightly increased if the case is not one of the graver kind. Beer is entirely forbidden.

The discharge of fluid from the body is promoted by such exercise as has been described; and if this is not possible a course of baths with packing should be taken several times in the year. Each course should last four or five weeks, and the baths should be taken about twice a week.

4. To prevent the deposit of fat the principles of diet already set forth must be carried into practice, as follows:

Morning.—One cup of coffee or tea, with a little milk, altogether about 6 oz. Bread, about 3 oz.

Noon.—3 to 4 oz. of soup, 7 to 8 oz. of roast or boiled beef, veal, game, or not too fat poultry, salad or a light vegetable, a little fish (cooked without fat, if desired), 1 oz. of bread or farinaceous pudding (never more than 3 oz.), 3 to 6 oz. of fruit, fresh preferred, for dessert. It is desirable at this meal to avoid taking fluids, but in hot weather or in the absence of fruit 6 to 8 oz. of light wine may be taken.

Afternoon.—The same amount of coffee or tea as in the morning, with at most 6 oz. of water; an ounce of bread as an exceptional indulgence.

Evening.—One or two soft-boiled eggs, an ounce of bread, perhaps a small slice of cheese. Salad and fruit, 6 to 8 oz. of wine with 4 or 5 oz. of water.

A larger quantity of liquid than that prescribed should never be taken at one meal. It is best to drink the quantity allowed in small portions at different times in the day.

In simple corpulency, without any disturbances of the circulatory organs, the quantity of fluid may be gradually increased; one or two glasses of wine may be permitted at the midday meal, and half a bottle of wine and half a pint of water in the evening.

Such is the so-called "Schweninger" or "Oertel cure."

What, however, especially characterizes Schweninger's modification of this method is the *entire suppression of any beverage at meals.* Whatever fluid is taken must be drunk two hours after food.

Germain Sée protests against the limitation of beverages in some of the foregoing systems. He maintains, on the contrary, that an abundance of water is most useful. "I have been able," he says, "to treat and cure a great number of cases by a *régime* of albuminates and fats, together with a great quantity of drink, especially of warm aromatic drinks."[1] Hot tea is the beverage he especially favors. Water, he urges, aids digestion by its solvent power, stimulates organic changes in the tissues, and promotes the elimination of waste material. The strict limitation of water, he points out, must be very injurious in those gouty constitutions with a tendency to uric-acid deposits, which so often show a disposition to corpulency. "The most useful beverages," he says, "are infusions of tea and coffee; and the preference should be given to tea, taken at breakfast in considerable quantity and at a high temperature. All obese persons who take this beverage habitually at or between their meals obtain better results than from pure water, even taken cold."

Alcoholic drinks he strictly forbids on account of their well-known tendency to favor fatty degeneration. A little wine and water is the most he permits.

He approves of Ebstein's system, with the modification here indicated, and reports excellent results from its application. He has, however, observed some difficulty in digesting the fats, and some dyspepsia provoked in certain instances.

S. Weir Mitchell[2] advocates "rest, milk diet, and massage in people who are merely cumbrously loaded with adipose tissue, and also in the very small class of anæmic women who are excessively fat." He maintains that on skimmed milk—*i. e.* milk without cream—fat people lose flesh, and that a large amount of weight may be got rid of rapidly and safely by the following means: "The person whose weight we decide to lessen is placed on skimmed milk alone, with the usual precautions, or at once we give skimmed milk with the usual food, and in a week put aside all other diet save milk, and all other fluids. When we find what quantity of milk will sustain the weight, we diminish the amount by degrees until the patient is losing a half pound of weight each day, or less or more, as seems to be well borne.

[1] *Du Régime alimentaire; Régime des Obèses.* [2] *Fat and Blood,* pp. 104–106.

"Meanwhile, during the first week or two rest in bed is enjoined, and later, for a varying period, rest in bed or on a lounge is insisted upon, while at the same time massage is used once or twice a day, and later in the case Swedish movements. At the same time the pulse and weight are observed with care, so that if there be too rapid loss or any sign of feebleness the diet may be increased. In many such cases I allow daily a moderate amount of beef or chicken or oyster soup, more as a relief to the unpleasantness of a milk diet than for any other reason. When the weight has been sufficiently lowered we add to the diet beef, mutton, oysters, etc., and finally arrange a full diet list, to include but a moderate amount of hydrocarbons. Meanwhile, the milk remains as a large part of the food, and the active Swedish movements are still kept up as a habit, the patient being directed by degrees to add the usual forms of exercise. If we attempt to make a speedy change in weight while the patient is afoot, the loss is apt to be gravely felt; but with the precautions here advised it is interesting and pleasant to see how great a reduction may be made in a reasonable time without annoyance, and with no obvious result except a gain in health and comfort."

The great difficulty in applying this method lies in the enforced rest in bed for a week or two which it requires, and which few men engaged in any kind of occupation would be willing to adopt. It is more applicable therefore to women without serious occupation.

In reviewing these various dietetic methods of treating obesity, it will be seen, as we have already pointed out, that they all aim at reducing the average quantity of food taken. If we compare the normal average daily ration with that permitted in these methods, this fact becomes very evident:

	Albuminates.	Fats.	Carbohydrates.
Normal average (grammes)	124	55	435
Banting	170	10	80
Ebstein	100	85	50
Oertel	155–179	25–40	70–110

The carbohydrates are especially attacked in all these methods, and very largely reduced. There would seem to be a far greater tendency to excess in this class of food than in the other classes. In two of these methods there is an excess of albuminates; this excess has been considered to favor the reduction of obesity by promoting the oxidation and combustion of the excess of deposited fat. This view of the effect of an excess of albuminates has been carried to an extreme in a method sometimes spoken of as the "Salisbury" method. It is usual in this method to restrict the diet absolutely for a time to large quantities

of rump steak, codfish, and hot water. One of the strongest advocates[1] of this method mentions three pounds of rump steak and one pound of codfish, together with six and one-third pints of hot water, as the daily diet for the first fortnight. The next three weeks the hot water is reduced to four pints, and other kinds of lean meat and fish are allowed, as well as a little green vegetable and unsweetened rusks. During the following month the hot water is reduced to about a quart a day, and some crusts of stale bread, captain's biscuits, grilled meat, or poultry or game of any kind, and hock or claret with seltzer-water, are allowed. A slice of lemon may be used to flavor each tumbler of hot water. Five grains of bicarbonate of potassium are also prescribed night and morning.

This last method, whatever may be its real merits, would be absolutely impossible of application in many cases, from utter inability to consume so large an amount of animal food. Inordinately large eaters might, however, find it successful.

Ebstein's method has the recommendation, no doubt, of diminishing the desire for food, and is applicable to the strong and vigorous with large appetites. The deficiency in albuminates and excess of fats render it unsuited to feeble subjects with weak digestions.

Schweninger's system is fairly applicable to many cases, but the absolute exclusion of all drink during meals, although it no doubt has the effect of considerably diminishing the desire to eat in excess, disagrees with many persons of feeble digestion, and should not be incautiously prescribed.

In Banting's system there is too rigorous an exclusion of fats, which are essential to healthy nutrition.

Certain cases undoubtedly do well with a strict limitation of beverages; others, on the contrary, as pointed out by Germain Sée, are better for the free use of hot, diluent drinks, and these are especially the gouty cases with a tendency to defective elimination. It is in such cases that a half pint of hot water taken half an hour before each meal and at bedtime answers well, and enables them to do with much less fluid at meal-times than is usually taken.

The two principal objects of all these methods is, first, to make the corpulent person consume the excess of fat deposited in his body by restricting the food-supply, or augmenting its combustion by increased physical exercise or other means; and, second, to establish a dietary which shall prevent its re-accumulation.

Neither of the methods described is appropriate to the treatment of all cases of obesity indiscriminately, while either of them may prove successful in suitable instances.

In conclusion, the following is the method which we recommend to

[1] W. Towers-Smith.

be generally adopted. A very careful examination should be made of each case in order to ascertain the presence or absence of any organic disease, especially of any cardiac degeneration, and if we are satisfied that the obesity is not secondary to any other morbid state or associated with any general degeneration of organs, we may proceed with confidence to prescribe an appropriate *régime:*

The albuminates in the form of animal food should be strictly limited. Farinaceous and all starchy foods should be reduced to a minimum. Sugar should be entirely prohibited. A moderate amount of fats, for the reasons given by Ebstein, should be allowed.

Only a small quantity of fluid should be permitted at meals, but enough should be allowed to aid in the solution and digestion of the food. Hot water or warm aromatic beverages may be taken freely between meals or at the end of the digestive process, especially in gouty cases, on account of their eliminative action.

No beer, porter, or sweet wines of any kind to be taken; no spirit, except in very small quantity. It should be generally recognized that the use of alcohol is one of the most common provocatives of obesity. A little hock, still Moselle, or light claret with some alkaline table-water is all that should be allowed. The beneficial effects of such a diet will be aided by abundant exercise on foot and by the free use of saline purgatives, so that we may ensure a complete daily unloading of the intestinal canal.

It is only necessary to mention a few other details. Of animal foods, all kinds of lean meat may be taken, poultry, game, fish (eels, salmon, and mackerel are best avoided), eggs.

Meat should not be taken more than once a day, and not more than six ounces of cooked meat at a time.

Two lightly-boiled or poached eggs may be taken at one other meal, or a little grilled fish.

Bread should be toasted in thin slices and completely, not browned on the surface merely.

Hard captain's biscuits may also be taken.

Soups should be avoided, except a few tablespoonfuls of clear soup.

Milk should be avoided, unless skimmed and taken as the chief article of diet. All milk and farinaceous puddings and pastry of all kinds are forbidden.

Fresh vegetables and fruits are permitted.

It is important to bear in mind that the actual quantity of food permitted must have a due relation to the physical development of the individual, and that what would be adequate in one case might be altogether inadequate in the case of another person of larger physique.

Food in Leanness and Defective Nutrition.—If it is sometimes difficult to reduce the proportions of the corpulent, it is usually far

more so to increase the weight and plumpness of the thin and emaciated. This arises from the circumstance that many cases of emaciation and defective nutrition depend on the existence, latent or declared, of serious organic disease; in others there seems to be an hereditary tendency to leanness; and in others the defective nutrition depends on a neurasthenic state, and in still others on grave functional disturbances of digestion. When definite disease of the digestive organs, organic or functional, can be detected, the dietetic treatment of such cases must be in acccordance with the rules already laid down for the management of such diseased conditions. Restless states of the nervous system, associated with worries and anxieties, present insuperable obstacles to improving the nutrition of the organism; and these must first be allayed before any lasting advantage is likely to be gained from an appropriate dietary.

The same principles that guide us in framing a *régime* which shall arrest the progressive emaciation of the neurasthenic and the consumptive patient will be found to apply to those less grave forms of leanness which we are called upon to treat, and where we cannot detect the presence of any serious malady.

For the appropriate dietetic and other management of those cases of neurasthenia or nervous exhaustion in which the general nutrition is so gravely affected that quite phenomenal states of emaciation and muscular feebleness are observed in connection therewith, we are mainly indebted to Dr. S. Weir Mitchell. These cases cannot, however, be restored to health by appropriate food alone, but other curative agencies have to be simultaneously and systematically employed. These are complete isolation, rest in bed, and the regular application of massage and electricity. To use Dr. Mitchell's own words, the method consists of "a combination of entire rest and of excessive feeding, made possible by passive exercise obtained through the steady use of massage and electricity."[1] He insists on the intimate association between the gain and loss of fat and the gain and loss of blood-corpuscles. "The loss of fat . . . . nearly always goes along with conditions which impoverish the blood; and, on the other hand, the gain of fat, up to a certain point, seems to go hand in hand with a rise in all other essentials of health, and notably with an improvement in the color and amount of the red corpuscles. . . . . To gain in fat is nearly always to gain in blood." It may also be well to let Dr. Mitchell himself describe the cases to which he considers his method especially applicable. They are "people who are kept meagre, and often also anæmic, by constant dyspepsia in its varied forms, or by those defects in assimilative processes which, while more obscure, are as fertile parents of similar mis-

[1] *Fat and Blood: An Essay on the Treatment of Certain Forms of Neurasthenia and Hysteria*, 5th ed., 1888.

chief. . . . . That large group of women especially said to have nervous exhaustion or who are defined as having spinal irritation, ... cases in which, besides the wasting and anæmia, emotional manifestations predominate, and who are then called hysterical, whether or not they exhibit ovarian or uterine disorders; . . . . women who have lost flesh and grown colorless, but have no hysterical tendencies, ... hopelessly below the standard of health, and subject to a host of aches and pains, without notable organic disease."

The large amounts of food given in this method while the patient takes no exercise are absorbed and utilized through the influence of massage, "kneading the muscles, and by moving them with currents able to effect this end." To ensure the most absolute rest in cases of great weakness the patient is fed by a nurse, and when well enough to sit up in bed the meats are cut up, so as to make it easier for the patient to feed herself.

The treatment is begun by putting the patient on milk diet—three or four ounces every two hours, increased in a few days to two quarts, given in divided doses every three hours. This, says Dr. Mitchell, "nearly always dismisses, as by magic, all the dyspeptic conditions." The bowels are regulated by giving a cup of coffee, without sugar, on waking, or a pill of watery extract of aloes at bedtime, or in more obstinate cases a quarter of a grain of watery extract of aloes and two grains of dried ox-gall thrice a day.

After from four to seven days a light breakfast is permitted; a day or two later a mutton chop as a mid-day dinner; and again, in a day or two, bread and butter thrice a day. After ten days, usually, the patient is allowed three full meals daily, as well as three or four pints of milk, given at or after meals, in place of water, and from two to four ounces of fluid malt extract before each meal.

"No troublesome symptoms usually result from this full feeding, and the patient may be made to eat more largely by being fed by her attendant. I like to give butter largely, and have little trouble in getting this most wholesome of fats taken in large amounts. A cup of cocoa or of coffee with milk on awaking in the morning is a good preparation for the fatigue of the toilet. At the close of the first week I like to add 1 lb. of beef, in the form of raw soup. This is made by chopping up 1 lb. of raw beef, and placing it in a bottle with one pint of water and five drops of strong hydrochloric acid. This mixture stands in ice all night, and in the morning the bottle is set in a pan of water at 110° Fahr., and kept two hours at about this temperature. It is then thrown on to a stout cloth and strained until the mass which remains is nearly dry. The filtrate is given in three portions daily. If the raw taste prove very objectionable, the beef to be used is quickly roasted on one side, and then the process is completed in the manner

above described. The soup thus made is for the most part raw, but has also the flavor of cooked meat.

"In difficult cases I sometimes add, at the third week, ½ oz. of cod-liver oil, half an hour after each meal. If it lessen appetite or causes nausea, I employ it thrice a day as a rectal injection, and in cases where the large doses of iron used cause intense constipation I find the use of cod-liver oil enemata doubly valuable, by acting as a nutriment and by disposing the bowels to act daily. When given thus, I like to use it in an emulsion made with the juice drained off, after crushing the fresh pancreas of the beef in warm water. Enough of water to cover ½ lb. of chopped pancreas is allowed to stand for an hour in a warm kitchen, and then squeezed through a towel. An ounce is mixed with half that amount of oil and injected slowly thrice a day."—*Weir Mitchell.*

As to stimulants, when there is no question of breaking off the alcoholic habit, a small amount of stimulant has been found to assist in the rapid increase of fat, such as an ounce of whiskey daily in milk, or a glass of dry champagne, or Burgundy or other red wine. It increases the capacity to take food at meals. Alcohol, however, is not essential.

With the administration of *solid* food iron is given in large doses, and when the patient is able to sit up "rather full doses of sulphate of strychnine thrice a day, with iron and arsenic."

As to the consumption of this "vast amount of food," Dr. Mitchell observes: "I have watched again and again, with growing surprise, some listless, feeble, white-blooded creature learning by degrees to consume these large rations, and gathering under their use flesh, color, and wholesomeness of mind and body."

When the patient is taking the full diet it is necessary to watch the urine. When urates begin to be deposited, it must be regarded as a sign of overfeeding, and some reduction in the quantity of food must be made. Attacks of dyspepsia (which are apt to occur) or diarrhœa are met by reducing the diet one-half or returning to a milk diet for a day or two.

One or two examples may here be given to illustrate this method.

CASE 1.—(S. WEIR MITCHELL.)

Mrs. C——, kept in bed, fed by an attendant, rose only to relieve bladder and rectum.

1st day.—One quart of milk, in divided doses, every 2 hours.

2d day.—Cup of coffee on waking. Two quarts of milk, in divided portions, every 2 hours. Aloetic pill at night.

3d to 6th days.—Same diet.

7th, 8th, and 9th days.—Same diet, with a pint of *raw* soup, in three portions.

10th day.—7 A. M., coffee. 7.30 A. M., ½ pint milk. 10 A. M., ditto. 12 noon, 2, 4, 6, 8, and 10 P. M., ditto. Soup at 11 A. M., 5 and 9 P. M.

14th day.—Egg and bread and butter added.

16th day.—Dinner added and iron.

19th day.—The entire diet was as follows: 7 A. M., coffee. 8 A. M., iron and malt extract; breakfast, consisting of a chop, bread and butter, a tumbler and half of milk. 11 A. M., soup. 2 P. M., iron and malt; dinner of anything she liked, with 6 oz. of Burgundy or dry champagne, and at the end one or two tumblers of milk. 4 P. M. soup. 7 P. M., malt, iron, bread and butter, usually some fruit, and commonly two glasses of milk. 9 P. M., soup. 10 P. M., aloetic pill.

(At 12 noon, *massage* for an hour. At 4.30 P. M., electricity applied for an hour.)

At 6th week soup and wine were dropped, iron lessened one half, massage and electricity only on alternate days; $\frac{1}{30}$th of a grain of sulphate of strychnine thrice a day at meals (continued for several months).

At 9th week, milk reduced to a quart. All mechanical treatment ceased.

Result.—Gain in flesh about face in 2d week. Weight rose in two months from 96 to 136 lbs., gain in color equally marked. At 30th day patient had normal catamenial flow, after 5 years of failure to menstruate. At 9th week drove out. Cure complete and permanent.

CASE 2.—(DR. PLAYFAIR.)

A. B.—age 32. Rest in bed, isolation.

1st day.—22 oz. of milk, in divided doses.

2d day.—50 oz. of milk, in divided doses.

3d day.—50 oz. of milk, in divided doses. (Massage ½ an hour.)

4th day.—50 oz. of milk, in divided doses; egg and bread and butter; dialyzed iron, 40 minims, in 2 doses. (Massage 1½ hours.)

6th day.—50 oz. of milk, in divided doses; mutton chop. (Massage 1 hour 50 minutes.)

8th day.—50 oz. of milk, in divided doses; mutton chop; porridge and a gill of cream; maltine twice daily. (Massage 3 hours; electricity ½ an hour; continued to end of treatment.)

15th day.—Three full meals daily of fish, meat, vegetables, cream, and fruit; 2 quarts of milk, and 2 glasses of Burgundy.

22d day.—Amount of food lessened.

Result.—On the 22d day sat in a chair for an hour; after a month walked down stairs and went out for a drive. "Enormous increase in size." Cure complete and permanent.

This method, as adopted by Leyden, is thus described by Germain Sée:

At 7 A. M.—Half a litre of milk, slowly sipped in ½ an hour, a small cup of coffee with cream, 80 grammes (nearly 3 oz.) of cold meat, a plate of fried potatoes.

10 A. M.—A litre of milk, with 3 biscuits.

12 noon.—The same.

1 P. M.—Broth, 200 grammes (about 7 oz.) of fowl, a *purée* of potatoes, green vegetables, 120 grammes (about 4 oz.) of *compôte* and pastry.

3.30, 5.30, 8, and 9.30 P. M.—Half a litre of milk, making a daily consumption of 3½ litres of milk.

In the after part of the day two meals, each of 80 grammes (3 oz.) of roast meat, with bread and 3 biscuits.

In all these cases the milk should be well skimmed and slowly

taken in mouthfuls at a time. It may, when necessary, be flavored with a little tea or coffee or caramel or salt. Its digestion is often aided by scalding with one-fourth the quantity of boiling water, and a few grains of bicarbonate of sodium or a little alkaline water—Vichy, Vals, or Apollinaris—may be added.

In the dietetic treatment of the malnutrition and emaciation of consumptives it is a generally accepted rule that fats and carbohydrates, the especially fattening forms of food, should take a prominent place. A proper proportion also of albuminates must be included in their dietary. One of the greatest difficulties we encounter in providing a suitable and adequate diet for consumptives is the frequency with which they complain of digestive troubles, want of appetite, and occasionally of positive disgust for food. Under such circumstances it is most important to provide well-cooked, appetizing, and attractively-served food, varied as much as possible, and, so far as is consistent with wholesomeness, agreeable to the tastes of the patient. In the distinctly febrile forms it will be advisable to give small quantities of nutritious food at short intervals.

Phthisical patients whose digestive functions are unimpaired may be allowed to partake of the various nourishing forms of food that enter into the ordinary dietary of the healthy, in addition to which two or three glasses of milk should be taken at convenient intervals between meals, and one of these glasses of milk should be taken the last thing at night, or preferably during the night if the patient is awake.

Milk is a most valuable food for the consumptive, and we have already mentioned the several expedients which may be adopted for promoting its digestibility when it is not well borne.

By adding to each glass of milk two tablespoonfuls of hot water in which about six grains of bicarbonate of sodium and five grains of common salt are dissolved, we can often remove the difficulty in the digestion of milk, particularly when the milk is very rich. When we find evidence that the patient really cannot digest the casein of milk—*i. e.* when we find hard curds of milk rejected by vomiting or giving rise to intestinal troubles and forming the chief part of bulky white motions—then we should make use of whey as a beverage. Its mode of preparation has already been described. A little cream may be added to it if desired.

Cream may also be made more digestible and more acceptable to many patients by mixing it with an equal quantity of hot water, and adding to each teacupful of the mixture a teaspoonful of the aromatic spirit of ammonia, although some prefer a teaspoonful of brandy. In other cases we may use peptonized milk.

Germain Sée considers the peculiar value of milk in phthisis to depend upon the fat it contains, and he argues that when enough milk

is taken to provide the requisite amount of the other elements necessary for the nutrition of the body, the fatty constituents are in large excess, and this he regards as its great recommendation. For an exclusively milk diet he estimates the necessary quantity at 3 litres (105 ounces), rather more than 5 imperial pints.

In many summer health-resorts[1] in Switzerland and Germany provision is made for following a "milk or whey cure," and in most of these sheep's, goat's, and ass's milk, as well as cow's milk, can be procured. There is no reason, however, for believing that goat's milk is more digestible than cow's milk, but in the case of diarrhœa it is thought to be preferable on account of the lime salts it contains. Ass's milk, however, like mare's milk, can often be taken when cow's milk has proved indigestible.

The utility of fatty substances in phthisis is undoubted, and in those cases in which we encounter an insuperable difficulty in procuring the acceptance or the digestion of cod-liver oil we may encourage our patients to consume as much fresh *butter* and good *cream* as they can digest.

Excellent results have been obtained, even in some advanced cases, from the administration of cream. We have already mentioned a suitable mode of giving it. Some order a little rum or brandy to be mixed with it. The addition of sugar or salt is said to aid its digestion, or it may be mixed with a little tea or coffee when these beverages do not disagree.

Cocoa and chocolate contain a notable quantity of fat, and are useful forms of food. Pancreatic emulsion will often be found serviceable when there is difficulty in digesting other forms of fat. Variety in food is most important, as well as its skilled preparation and cooking, and nearly all kinds of animal food, when suitably cooked, may be given to the consumptive.

The use of raw meat has been highly extolled, especially by some French physicians, and Professor Fuster of Montpellier has claimed the most brilliant results from its administration in cases of phthisis. These results have not, however, been confirmed by other observers, although it is generally admitted that in many cases of troublesome dyspepsia and loss of appetite, especially when associated with diarrhœa, raw meat has rendered real service.

Various expedients have been adopted to overcome the repugnance which most patients at first manifest for this form of food.

In all cases it should first be reduced to as fine a state of subdivision as possible by scraping or cutting and pounding, or, better still, by the use of the little machines now made for this purpose.[2] Raw meat may

[1] See my work on *Climate and Health-Resorts* (new ed.).

[2] Debove recommends that it should be "scraped with a knife, so as to detach all

also be reduced to a fine dry powder by first drying and then grinding it.

Pounded raw meat can, however, be made up into small round pellets, and covered with powdered sugar or gum or any other innocent covering, and swallowed with a little wine and water or brandy and water, or it can be mixed with a little hot clear soup. And it is especially well borne mixed with light tapioca soup; this can be flavored with any agreeable flavoring and drunk readily, and the mouth cleansed by drinking a few mouthfuls of weak brandy and water or claret and water after it.

In some parts of Germany the roes of salted herrings, and in France several species of snails, are thought to be especially useful as food for the consumptive.

The different kinds of farinaceous foods are all useful and appropriate articles of diet. Whole-meal or well-made brown bread is, on account of the phosphates contained in it, better suited to young consumptives, if they digest it well, than white bread. Lentil flour is also valuable, as it contains notable proportions of phosphates and of iron. Oatmeal is rich in fatty matters, and the flour of maize is still richer—a fact which renders them both very suitable additions to the diet of the tuberculous.

Malt extract is now largely employed as an addition to farinaceous food, the digestion and assimilation of which the *diastase* contained in it doubtless facilitates. It is possible also to procure malt bread and malt biscuits.

With regard to the use of alcoholic beverages, much difference of opinion exists. Some advocate the consumption of large quantities of alcohol in phthisis. Flint[1] quotes cases which appear to have been benefited by the consumption of as much as a pint of whiskey daily! We shall find, practically, that the use and need of alcohol vary greatly in different individuals. In some it diminishes appetite and retards digestion; in others it promotes both; and we shall encounter very few cases of phthisis which are not benefited, at some period of their course, by the discreet administration of alcoholic stimulants.

It is exceedingly necessary that the beverage, whether wine, spirits, or beer, should be pure and of the best quality.

When the patient is able to drink fermented *malt* liquors, he may be allowed one or two pints daily of good sound bitter beer or porter or stout; of wines, half a pint to a pint of really good Bordeaux or

the muscular fibres and separate them from the fibrous tissues;" and he points out that what renders it so valuable as a food is its extreme subdivision, which multiplies the surfaces of contact and allows each fibre to be completely bathed by the digestive juices; also, as it has not been hardened by cooking, it allows these juices to penetrate it more readily.—*La Tuberculose parasitaire,* p. 77.

[1] In his work on *Phthisis.*

Burgundy, or of some of the better descriptions of Hungarian, Italian, or Greek wines. Port and sherry we have found objectionable in most cases, disturbing digestion and often causing headaches; a proportionate quantity of whiskey or brandy is preferable to either of these wines.

Food in Anæmic Conditions.—Closely allied to states of malnutrition and emaciation are the anæmic conditions so commonly encountered amongst young females, especially about the age of puberty; and it will be convenient now to call attention briefly to the appropriate dietetic treatment of such cases.

Among the various causes of anæmia or hydræmia—by which is meant an alteration in the composition of the blood, so that it becomes poorer in red corpuscles and more watery—a defective or unsuitable supply of food must be regarded as one of the most frequent.

It has been proved that with a diet composed of exclusively non-nitrogenous food the percentage of hæmoglobin in the blood undergoes a notable diminution, while it is augmented by a diet rich in albuminates.

It is certain that much of the chlorosis, anæmia, and associated nervous disturbances observed amongst young girls at the age of puberty is referable to improper or insufficient feeding at school, together with the imposition of educational tasks to which they are unequal.

The more acute form of anæmia may be caused by hæmorrhage or may be the result of severe illnesses, and in the latter case considerable emaciation generally accompanies it.

With suitable food recovery is very rapid in most of these cases, and a moderate loss of blood is soon made up; the fluid part is, however, more quickly restored than the corpuscles.

In some chlorotic females it has been said that the heart and blood-vessels are abnormally small, so that they suffer from a congenital weakness in the blood-forming and blood-propelling apparatus; in such instances not only must great care be observed in the regulation of the diet, but all the organs of the body should be guarded from undue strain or any over-exertion.

In all cases of anæmia not only must we see that the supply of food is adequate and its quality suitable, but we must also watch over its digestion and assimilation. The functional disturbances which are associated with poor and watery blood are especially marked in the digestive organs, the secretions of which become defective both in quantity and quality, and dyspeptic troubles are therefore common accompaniments of the anæmic state.

It may often be observed in anæmic persons that while their muscles are feeble and wasted, they present a generally plump aspect, from the presence of a considerable amount of adipose tissue. This has been referred to defective oxygenation from the decrease in red blood-corpus-

cles, the carriers of oxygen, and consequent imperfect combustion of the hydrocarbons and carbohydrates.

From these considerations we are able to deduce the following indications for the dietetic treatment of cases of anæmia and chlorosis:

1. The food should contain the elements needed for the restoration of the deficient blood-corpuscles and the general normal integrity of the circulating fluid.
2. It should be directed to restoring tone to the enfeebled muscles, and especially to the cardiac muscle.
3. It should be supporting and soothing to the exhausted and irritable nervous system.
4. It should be of a kind and in a mode of preparation which renders it easily and quickly appropriated by the organs of digestion and assimilation—processes especially languid and feeble.

At the outset of the treatment *rest* of the exhausted organism should be particularly enforced. The tendency to urge the young who are feeble and anæmic to take abundant exercise, and to make them follow the same mode of life as their healthy associates, cannot be too strongly condemned. It interferes with the success of all our remedial measures.

The food given at first should be in small or moderate quantity, so as not to overtax the feeble digestive powers, and in a form that can be readily digested.

Milk, skimmed if necessary, is most useful when it is easily digested; but it must not be persevered with when it is digested with difficulty, and is on that account distasteful to the patient. Peptonized milk, a breakfast-cupful twice or three times a day, may be given when unprepared milk disagrees.

All forms of animal food, prepared in a manner easy of digestion, are useful and appropriate. Raw or slightly-cooked meat, pounded or scraped and mixed with agreeably-flavored consommé or meat-broth, or made into sandwiches, or mixed with chocolate or Burgundy and water, or given in any wholesome form approved of by the patient, is of great value as a blood-restorer.

Germain Sée states that he has often cured cases of chlorosis without iron, or after iron has failed, by the administration of 400 grammes (about 14 ounces) of raw meat daily, together with hydrotherapy; and he considers those two means as indispensable in the treatment of dyspeptic chlorotics who cannot take iron, and the former also in those cardiac cases which cannot tolerate either iron or hydrotherapy.[1]

The digestive power for nitrogenous or other foods must be carefully watched, and, if necessary, aided by the addition of some appropriate digestive ferment. A few grains of pepsin may be given with each meat meal.

[1] *L'Hygiène alimentaire*, p. 420.

To obviate the tendency to constipation, well-made whole-meal bread may be given, watching again carefully for any signs of indigestion which it is apt occasionally to provoke. For the same purpose oatmeal porridge may be taken at breakfast, and some fruit *compôte*.

Green, fresh vegetables, especially in the form of *purées*, are also to be recommended for the same purpose. Maccaroni, vermicelli, polenta, and the various Italian pastes, cooked with meat-juice or gravy, are excellent.

Animal albuminates should predominate in the diet at first, given in quantity proportionate to the digestive capacities. Some easily-digested fat—particularly in cases in which there has been loss of flesh—should soon be added; indeed, progress in blood-making will often fail to take place until some digestible fat be added to the dietary. A dessertspoonful of cod-liver oil once a day will frequently suffice, and should be ordered when it is not objected to. When this is objected to, some other form of fat should be introduced into the daily dietary. Butter is one of the best; so is cream. They may be agreeably mixed with some farinaceous food in the form of light puddings and served with fruit-sauce or jelly. Broiled fat bacon at breakfast is, with many persons, an easily-digested form of fat.

Eggs in any form, especially the yolks, are a very suitable food, as they present a concentrated and generally easily-digested form of nutriment rich in iron. The yolks of one or two eggs, beaten up with a little boiling water, with or without milk, to which a little sugar, nutmeg or other spice, and a tablespoonful of brandy may be added, is an excellent and nutritious restorative in those cases of anæmia with cardiac feebleness and loss of appetite.

Bauer[1] is decidedly in favor of a liberal proportion of nitrogenous food in the dietary of anæmic patients. "It is probable," he says, "that the reproduction of the most essential components of the blood, especially of the red corpuscles, would be greatly favored if relatively more albumin were contained in the food of such patients than is proper under physiological conditions."

The class of *fat* anæmic people—mostly women—are alluded to by Dr. S. Weir Mitchell as of the "utmost clinical interest." They are rare, as he remarks, and must be dependent on conditions not common to all anæmics. Those that we have seen have been apparently traceable to long-continued faults of diet, especially to the avoidance of nitrogenous food and the consumption of a vastly-increased proportion of carbohydrates.

One of the most remarkable cases of this kind we ever observed was in a patient who had a perfect mania for pastry-cooks' sweets. She spent large sums of money habitually at the pastry-cooks', and when

[1] *Dietary of the Sick; Diet in Anæmia and Hydræmia*, p. 275.

any impediment was put in her way she would succeed, by all sorts of ingenious contrivances, in getting her usual supply of sweets. This enormous consumption of carbohydrates in combination with fat (as in pastry) was of course associated with entire indifference to animal food.

"Obesity with thin blood" is certainly, as Dr. Mitchell maintains, a "most unmanageable condition." The most useful treatment he believes to be a combination of an exclusively milk diet—well-skimmed milk—with rest and massage:

"In old cases of this kind the best plan is to put the patient at rest, to use massage, restrict the diet to skimmed milk or to milk and broth free from fat, and with them, when the weight has been sufficiently lowered, to give iron freely, and, by degrees, a good general diet, under which the globules rise in number, so that even with a new gain in flesh there comes an equal gain in strength and comfort."

He gives as an example the case of a lady aged forty-five, who weighed 190 pounds, her height being 5 feet $4\frac{1}{2}$ inches; she was also anæmic, feeble, and breathless.

"She was kept in bed five weeks. Massage was used at first once daily, and after a fortnight twice a day, while milk was given, and in a week made the exclusive diet. Her average of loss for thirty days was a pound a day, and the diet was varied by the addition of broth after the third week, so as to keep the reduction within safe limits. . . . . After two weeks I gave her the lactate of iron every three hours in full doses. In the fourth week additions were made to her diet-list, and Swedish movements were added to massage, which was applied but once a day; and during the fifth week she began to sit up and move about. Her weight at the seventh week had fallen to 145 lbs., and her appearance had decidedly improved. . . . . Now, after two years, she is a well and vigorous woman."

Forced Feeding (*"Alimentation forcée"* of the French).—Debove discovered, by accident, that in cases in which all food introduced into the stomach in the ordinary way was rejected by vomiting, strange to say, food introduced by the œsophageal tube was retained; and on this observation he founded his method of artificial *"suralimentation."* He finds that he is able to introduce into the stomach by this means an "excess" of food which is retained and digested; and he truly observes that a person with phthisis requires considerably more food than a person in health, on account of the considerably greater bodily waste taking place. He has also observed that the digestive power of the patient has no relation to the appetite. "A patient who has no appetite, or who has a marked disgust for all food, will digest perfectly a large meal introduced by the tube, and even at the end of a certain time will recover appetite."[1]

[1] *Leçons cliniques et thérapeutiques sur la Tuberculose parasitaire*, p. 82.

As the results of *suralimentation*, or excess of food, he has observed disappearance of night-sweats, diminution and disappearance of cough and expectoration, increase of strength, rapid gain in weight, and at the same time a considerable amelioration in the physical signs.

By the use of powdered raw meat, Debove and Dujardin-Beaumetz in Paris, and Peiper in Griefswald, have been able to apply the principle of *suralimentation* without the necessity of using the œsophageal tube.

Dujardin-Beaumetz gives the following instructions for making this powder: Take the lean of beef, cut it up into small pieces, dry it in a water-bath; when thoroughly dried reduce it to powder in a coffee-mill or by means of a machine constructed by Galante (No. 2, Rue de l'École de Médecine, Paris). This powder can be mixed with lentil flour and taken in the form of soup, or, better still, it may be mixed with chocolate or with grog—"*grog de la poudre de viande.*" To make the latter, place in a bowl two tablespoonfuls of meat powder; to this add three dessertspoonfuls of "syrup of punch" (essence of rum punch), and enough milk to make a perfectly fluid mixture. By these means from 1500 to 6000 grains of meat powder can be given daily;[1] the latter quantity would be equivalent to 24,000 grains, or three and a half pounds of raw meat. Or it may be given, as recommended by Debove, simply mixed with milk, first adding just enough milk to make a smooth paste, and then mixing in the remainder, so as to make a uniform fluid mixture that can be readily drunk. It is necessary in using these powders to see that they are genuine and not over-dried.

Since the adoption of powdered raw meat for *suralimentation* the introduction of food into the stomach by means of the œsophageal tube is reserved for those cases in which, owing to irritability of the gastric mucous membrane, food taken in the ordinary way cannot be retained in the stomach.

Special Dietetic Cures.—(*a*) *The Milk and Whey Cures.*—The so-called "milk cure" has been systematically applied to the treatment of many chronic maladies. Karell, of St. Petersburg, has been one of the chief advocates of an exclusively milk diet in certain diseases, and S. Weir Mitchell has to some extent adopted his views and extended their application.

The following are the diseases in the treatment of which an exclusively milk diet has been found of value: Dropsies of all kinds, cardiac, renal, and hepatic; obstinate intestinal neuralgias; incorrigible dyspepsias with grave disturbances of nutrition; hepatic disorders, such as hyperæmia, simple hypertrophy, and fatty liver; asthma, when the consequence of pulmonary catarrh and emphysema; hysteri-

[1] Dujardin-Beaumetz: *L'Hygiène alimentaire*, Paris, 1887.

cal and hypochondriacal states associated with serious disturbances of nutrition; and especially in disorders of nutrition dependent on latent catarrhs of the stomach and intestine.

Karell considers that the methodical application of his milk cure produces its curative effects by acting as a *regulator of nutrition;* and he maintains that it is highly beneficial, not only in the cases already enumerated, but also in rheumatic and gouty affections, in organic diseases of the heart and advanced renal degeneration, and especially in degeneration of the arteries.

Both Karell and Mitchell direct that the milk used should be *well skimmed*, and as creamless as possible, and it should be obtained fresh twice daily from country-fed cows. They also agree that at first the doses should be small. Mitchell prescribes 4 ounces every two hours, and as the dose is increased the interval between the doses is lengthened to three hours: he also allows a glass during the night, to which a little lime-water is added to keep it sweet.

Karell commences with from 3 ounces to 6 ounces three or four times a day. He insists on the doses being rigorously fixed and scrupulously adhered to, and that no other food be taken. The doses should be taken at equal intervals, and drunk slowly in small mouthfuls, so that the saliva may mix with it. Taken in this way it will be readily digested, whereas drunk *ad libitum* it would cause indigestion. In winter the milk should be warmed by standing the glass in hot water; in summer it should be of the temperature of the apartment. It should not be boiled except in rare cases of diarrhœa.

If the milk is well digested, as indicated by small solid motions, the dose is slowly increased. The first week is the difficult one to get over; during the second week two bottles a day may be taken at fixed intervals—viz. 8 A. M., 12 noon, 4 P. M., and 8 P. M. These hours may be changed, but the intervals must be maintained.

When there is great objection on the part of the patient to its use, with nausea or disgust, Weir Mitchell allows it to be flavored with a little tea, coffee, caramel, or salt. He also advises in certain cases that the general diet should be displaced slowly until the exclusive milk diet can be tolerated. When it provokes acidity some alkali may be added, such as lime-water or Vichy water, or it may be scalded with boiling water and a little carbonate of sodium, and salt added, or a little barley- or rice-water may be mixed with the milk to prevent firm clotting.

Karell asserts that although he commences with such small doses, the patients never complain of either hunger or thirst; and he adds that if patients who are seriously ill attempt to take, instead of the four cups of skimmed milk, four large glasses of milk direct from the cow, they will certainly not be able to digest it, and the treatment will be dis-

credited. In obstinate sickness and diarrhœa he has obtained the best results from these small doses, and he cites one such case in which he gave only four tablespoonfuls of skimmed milk three times a day. No doubt in a case of this kind the almost absolute rest of the digestive organs which such treatment affords is an important agent in the cure.

Constipation he considers a natural consequence and a good sign—a sign that the milk is absorbed. It may be remedied by a simple enema of water or by a small dose of castor oil or rhubarb, and if obstinate a little coffee should be mixed with the morning milk, or some stewed prunes or a baked apple may be eaten at 4 P. M.

Flatulence is, as a rule, completely relieved by this diet; if, however, any flatulence or diarrhœa should be complained of, it is owing either to imperfect skimming of the milk or to its being taken in too large a quantity. Thirst may be relieved by simple water or seltzer-water.

If during the second or third week there should be a great desire for solid food, a little stale bread with salt or a small portion of a salted herring is permitted; and once a day a little soup made with milk and thickened with groats. After five or six weeks some modification is admissible; milk, however, should still be taken three times a day, and some other suitable food at dinner.

Mitchell allows Nestlé's or some other similar food to be substituted as the case progresses. To objectors Karell says: "Milk is a food easy of digestion for everybody, provided it is given with precaution in strictly measured doses and is of good quality." He states that he has obtained excellent results in desperate cases in which other remedies had proved useless, and especially in chronic gastric and intestinal disorders.

Mitchell points out the importance of combining rest with this treatment at the commencement, as the patients lose weight at first and feel weak on account of the small amount taken; after long use, however, they increase in weight. For the first week or two it also causes sleepiness. The tongue becomes covered with a white, thick fur, and the patients complain of an unpleasant sweetish taste in the mouth on waking. The stools are of a yellowish color and have a peculiar odor. There is usually a large flow of urine,[1] which may exceed in quantity the fluid ingested, and so lead to the removal of dropsical effusions. Weir Mitchell has also observed that uric acid disappears almost entirely from the urine, which assumes "a singular greenish tint," and when hot nitric acid is poured upon it, it no longer gives the usual mahogany tint at the plane of contact, and it would seem that during a diet of milk "the ordinary pigments of the urine disappear

[1] It has recently been stated by G. Sée and Dujardin-Beaumetz that *lactose* given alone acts as a powerful diuretic.

or are singularly modified." The substances which give rise to the ordinary fæcal odors also disappear.

"The changes here pointed out are remarkable indications of the vast alterations in assimilation and in the destruction of tissues which seem to take place under the influence of this peculiar diet." [1]

The Whey Cure.—In many of the German and Swiss spas, and especially in those with alkaline and salt springs, where chronic catarrh of the respiratory organs is treated, such as Ems, Ischl, Reichenhall, etc., the so-called "whey cure" is applied. This consists in drinking warm whey, either alone or mixed with the mineral water, in definite quantities, at set times. Many physicians regard this practice as in all respects similar to the use of skimmed milk, and in no respect preferable except in persons who find the casein of milk indigestible. About 20 ounces daily are taken.

It relieves irritable laryngeal coughs and exercises a favorable influence over chronic laryngeal and bronchial catarrhs. It has been found useful in certain forms of dyspepsia and in chronic phthisis. It acts also as a diuretic, especially in combination with the saline mineral waters, and recent observations have shown that *lactose* possesses distinctly diuretic properties.

The "whey cure" is not an exclusive diet cure, but it is usual to limit strictly the quantity of animal food taken and to augment the amount of fruit and vegetables; it adds, however, to the diet a certain amount of milk-salts and milk-sugar. At the health-resorts mentioned whey is prepared from the milk of the sheep and the goat, as well as from cow's milk.

There are various methods of preparing whey. When an acid or when rennet is added to milk, the casein coagulates and forms the so-called *curd* of milk, and the fluid from which it separates is termed *whey.*

Rennet coagulates milk with an alkaline reaction, and forms what is called "sweet whey." In this process the casein is decomposed into the precipitated cheese and the slightly soluble whey-albumin.

The whey contains some soluble albumin and fat, and a great proportion of the salts and lactose, together with some lactic acid.

Mean Composition of Whey (BAUER).

Water	93.3
Albuminates	0.82
Fat	0.24
Lactose	4.65
Lactic acid	0.33
Salts	0.65

Whey, though not very nutritious, is an exceedingly useful fluid

[1] *Fat and Blood*, 5th ed. p. 103.

food when milk cannot be digested. As it is also a pleasant beverage, it can be given freely, and so a considerable amount of nutritive substance may in this manner be administered. It can be made with lemon-juice, or white vinegar, or white wine, or cream of tartar, or alum, as well as with rennet.

The following is Dr. Louis Starr's method of preparing whey, and this produces a more nutritious beverage than the ordinary mode of preparing it: Take half a pint of fresh milk heated to about 140° or 150° F., and 1½ teaspoonfuls of wine of pepsin or one teaspoonful of Fairchild's essence of pepsin, and stir just enough to mix. Let the mixture stand in a warm place until firm coagulation has taken place. Next beat up the curd until it is finely divided, and strain. Whey thus prepared not only contains in solution the sugar and the salts of the milk, but holds also in suspension a considerable portion of casein and fat, which passes through the strainer.

The Koumiss Cure.—*Koumiss*, the fermented milk of the steppe mares, is used as a food and as an intoxicating beverage by all the nomadic tribes of the south-eastern steppe country of Russia. But it is as a *systematic cure* in various maladies that we now refer to it. It is on the steppes themselves that the best koumiss and the best results of the koumiss treatment are obtained—although at Moscow and St. Petersburg institutions exist for the application of this cure—and where koumiss prepared from steppe mares is employed. A specially selected breed of mares yields the milk made use of. The summer climate of the steppes seems to be especially favorable to the treatment of pulmonary complaints, but the winters are extremely severe. The nomads appear to possess the art of making koumiss in the greatest perfection, but its composition is by no means stable. It is comparatively rich in sugar and poor in casein and fat.

Large quantities of koumiss can be easily digested, and it has been observed to exert a diaphoretic or a diuretic action according as the external temperature is high or low. Its use is constantly attended by a gain in weight.

Many cases of phthisis are reported to have been cured by this treatment when followed on the steppes of Orenberg or Ssamara, where, doubtless, the dry climate has also a curative influence.

The best koumiss is made from the milk of light-colored unbroken mares pasturing on the steppes near mountain-ranges, where they can get running water and salt-beds. They should be able to bathe frequently, and they must not have either hay or oats.

Two kinds are there prepared—one light and slightly fermented, the other strong and highly fermented.

The patients are made to rise early and take a glass of koumiss every half hour, except during the two hours preceding dinner and

supper. Meat and fats form the chief part of the ordinary food; sweets, fruit, and salads are avoided, as well as ices, coffee, and spirits. Lime-water is used to arrest the diarrhœa koumiss often causes. At first a few glasses only are taken daily, so as to accustom the patient gradually to the cure.

Most invalids digest it well; it relieves constipation and acts as a diuretic. They gain in weight and show signs of increased blood-formation. Tent-life and much exercise in the open air are no doubt important adjuncts to the cure.

Annaeff's and Postnikoff's establishments at Ssamara are the best places for following this cure.

Good koumiss is a milky-looking, frothy liquid, with an agreeable slightly acid taste. It contains 1 per cent. of alcohol and lactic acid. Its ready digestibility has been referred to the alcohol in it stimulating the digestive secretions, and the carbonic acid allaying gastric irritability.

The proportion of alcohol in koumiss is too small to produce any symptoms of intoxication, but a tendency to sleep and to mental and bodily languor has been noticed to follow its use. Excitement of the sexual organs has also been noted by several observers to follow the use of koumiss.

The treatment on the steppes lasts two or three months, and is often renewed the following summer.

Annaeff's establishment stands in a park on a hill on the banks of the Volga, three versts distant from Ssamara. It is provided with a library, theatre, and other comforts. The koumiss is prepared by a Tartar family in the sight of the patients and with due regard to cleanliness. In its manufacture the milk-sugar is converted into alcohol, carbonic acid, and lactic acid. The casein is in a state of fine subdivision most easy of digestion. Dr. Stange of St. Petersburg, who studied the koumiss cure in Annaeff's establishment, gives the following

Table of the Relative Composition of the Several Strengths of Koumiss.

	Mare's milk.	Koumiss—Duration of fermentation.			
		6 hours.	18 hours.	30 hours.	4 days.
Carbonic acid	—	3.8	6.0	7.0	11.0
Alcohol	—	18.5	19.5	30.0	30.0
Lactic acid	—	3.9	5.6	6.4	6.4
Milk-sugar	51	18.8	16.3		
Albumin	23	22.5	22.5	20.0	16.0
Fat	19	18.9	20.0	19.0	19.0
Salts	5	4.5	4.0	4.0	4.0

An analysis of koumiss, made in Moscow after two days' fermenta-

tion, gave—alcohol, 1.65 per cent.; fat, 2.05; milk-sugar, 2.20; lactic acid, 1.15; finely-divided casein, 1.12; salts, 0.28; carbonic acid, 0.70. Dr. Stange came to the conclusion that "favorable results can only be obtained from the koumiss cure on the steppes, since, besides the employment of a genuine koumiss, a hot and dry climate is absolutely necessary;" that it is especially beneficial in catarrhal conditions of the respiratory and gastric mucous membrane; that it is often successful in the first stage of phthisis; that in the second stage it simply improves the general condition, and in the third stage is badly borne; and that it is especially curative in cases of defective nutrition generally—cases of anæmia, chlorosis, malarial cachexia, scrofula, etc.

Artificial koumiss is prepared in Europe, largely from cow's milk. The cows should be fed in open pastures, and special means are adopted to diminish the relative amount of casein and increase the relative amount of sugar contained in cow's milk. It must be regarded as a food intermediate in character between milk and alcohol—more stimulating than the former, more tonic than the latter. Unfortunately, many persons cannot overcome their dislike to it as a beverage. When it is well borne it is found to be easy of digestion, often relieving dyspepsia and vomiting and producing increase of weight. It is appropriate to febrile cases, as it quenches thirst, and can often be retained in the stomach when all other food is rejected; indeed, its especial value is in those cases of inveterate dyspepsia and gastric irritability in which all attempts to give other kinds of food have failed.

The following comparison of the composition of mare's milk and koumiss is quoted from Hartier by Dujardin-Beaumetz:

In 1000 parts.	Mare's milk.	Koumiss.
Albuminates	19 to 28	11.20
Fatty matter	12 " 15	12.00
Lactose	53 " 57	22.00
Lactic acid	—	11.50
Carbonic acid	—	7.85
Alcohol	—	16.50
Salts (ash)	0.280	0.28

Kefyr is another fermented drink, prepared in the mountains of the Caucasus from cow's milk. This fermentation is brought about through the agency of a micro-organism, the *Dispora caucasica*, which is added to the milk, and which possesses the property of converting the lactose into alcohol and carbonic acid.

As cow's milk contains proportionately much less sugar than mare's milk, kefyr therefore contains less alcohol than koumiss.

The following analysis, quoted by Dujardin-Beaumetz, shows the relations between cow's milk and kefyr:

In 1000 parts.	Skimmed cow's milk. Sp. gr. 1.028.	Kefyr (medium quality). Sp. gr. 1.026.
Albuminates	48.00	38.00
Fats	38.00	20.00
Milk-sugar	41.60	20.025
Lactic acid	—	4.00
Alcohol	—	8.00
Water and salts	873.00	904.975

The Grape Cure.—This is another dietetic cure which must here be briefly described.

The nutritive value of grapes is not great; they, however, contain much sugar as well as potash salts. They are an agreeable form of food, and afford one of the few means at our disposal between nutritive substances on the one hand and medicinal substances on the other. Much of the benefit referred to this cure may doubtless be attributed to the climatic advantages presented by those agreeable localities, such as Meran and Montreux, where it is usually followed.

Professor Lebert speaks of the grape cure as essentially a dietetic cure, notwithstanding its refreshing and aperient effects; and he is quite opposed to the consumption of very large quantities, as has been advised by some authorities, and considers that only moderate quantities should be prescribed. The effect of the cure is aided by a good supporting diet. Patients with pulmonary disease should not take more than an average of 2 pounds daily, beginning with about a pound, and other patients should not exceed 4 pounds. In cases of gastric catarrh 3 pounds a day may be eaten, the diet at the same time being carefully regulated. Constipation, with hepatic congestion and "abdominal plethora," may be benefited by from 3 to 4 pounds daily, and in these cases the dose may, exceptionally, be increased to 5 or 6 pounds. The laxative influence of from 4 to 6 pounds of grapes eaten daily has been found beneficial in hæmorrhoidal affections and in cardiac diseases with a tendency to visceral congestion and venous engorgments, in hyperæmia of the liver, and in chronic constipation.

The tendency to renal and hepatic concretions is often advantageously modified by this cure. Professor Lebert remarks, as the result of his own observations at Montreux, that the grape cure is very valuable "to those who are neither ill nor well, who are fatigued by a too exciting and somewhat intemperate life; or, weakened by severe illnesses, are convalescing slowly; or who, leading habitually a too sedentary and too laborious an existence, find in our country, besides the grapes which regulate the digestive functions, all those hygienic conditions which they most need. In this way the passage of debility and fatigue into real diseases may often be prevented." It is best to begin with half a pound of grapes in the morning fasting (or an hour or two

after a light breakfast if they disagree when taken fasting), and another half pound at 5 P. M. After two or three days a third half pound should be taken between 11 o'clock and noon. Little by little the dose is increased to about a pound each time. In cases of pulmonary disease Lebert rarely exceeded the smaller quantity. In other cases which bear the cure well larger quantities may be prescribed. In some cases of dyspepsia a bunch or two at dessert may be substituted for the midday dose.

The aperient effect may not be manifest at first, but usually shows itself after a few days.

At Meran figs and pears are also permitted with the cure in order to diminish the repugnance to one kind of fruit alone.

Some irritation of the gums is apt to be excited during the cure; this may be relieved by rinsing the mouth with cold water to which a little bicarbonate of sodium is added. It has also been recommended that the patient should take while eating the grapes, from time to time, a small piece of fine white bread to remove the acid adhering to the teeth.

Toward the end of the cure, which lasts from four to six weeks, the quantity should be gradually diminished.

The mean composition of grapes, according to König, is—water, 78.17 per cent.; sugar, 14.36; free acid, 0.79; nitrogenous substances, 0.59; non-nitrogenous extractives, 1.96; stones and woody fibre, 3.60; total ash, 0.53. The ash consists chiefly of potassium salts, together with salts of lime and magnesium.

We have already indicated certain cases in which the grape cure may prove beneficial. It is also prescribed with success in those cases of "abdominal plethora" associated with a deposition of much superfluous fat; much of this fat may be removed if the laxative influence of the grapes is aided by a spare diet in which the fats and carbohydrates are strictly limited. It cannot be credited with any real curative influence in phthisis, but it appears to be useful in cases of chronic bronchial catarrh and emphysema; and it may no doubt relieve the bronchial catarrh which accompanies most cases of phthisis.

It has been found beneficial in cases of gastric and intestinal catarrh, in anæmic persons, in vesical catarrh, in gouty concretions, and in cases of malarial cachexia.

Artificial Digestive Agents and Predigested Foods.

The chief of those digestive agents which now form an important valuable addition to the therapeutic resources of the physician are (*a*) *Malt extracts;* (*b*) *Pepsin* and its preparations; (*c*) *Pancreatin* and the preparations into which it enters.

(*a*) **Malt Extracts and Malted Foods.**—These are simply pre-

digested starches, together with other nutritive substances, and it must not be concluded that they can supplement or reinforce the pancreatic digestion of starch *in the small intestine*, for the amylolytic ferments are wholly inactive in the presence of free acid, and the salivary (diastasic) ferment is under ordinary conditions destroyed in the stomach. The diastase of malt, like the salivary ferment, exerts its amylolytic action most energetically in a neutral fluid; the addition of an alkaline carbonate retards it, while a very slight amount of acid (such as the hydrochloric acid of the gastric juice) puts a stop to it. In the feeding of very young infants who cannot digest milk, and who, as we have seen, naturally lack the salivary and pancreatic secretions, when malted foods are used it is for the purpose of supplying predigested starch, which they are unable to digest from the lack of these ferments. It is possible that we might in old subjects convey the diastasic ferment safely through the stomach into the small intestine, if we desired to, by previously neutralizing the acid of the stomach by giving a little carbonate of lime or magnesium; but we should then be interfering with the action of one digestive ferment in order to reinforce that of another.

The diastasic power of malt extracts has been found inferior to that of ground malt itself, and these, as we have said, must be regarded rather as preparations of soluble foods than as digestive agents. They contain, besides the diastase of the malt and predigested starch (dextrin and maltose), some of the albuminates and salts of the barley. Like ground malt, when added to farinaceous foods and kept at a temperature below 150° F. they promote the transformation of the starches into dextrin and sugar; but it is an error, as we have just pointed out, to suppose that they continue this amylolytic action when taken into the stomach.

Many varieties of "malted foods" are now in common use, but "Liebig's Infants' Food" may be taken as the prototype of all these. It contains ground malt, wheat flour, potassium bicarbonate, and milk, and it is directed to be made in the following manner:

Mix well ½ an ounce of ground malt with ½ an ounce of wheat flour and 7¼ grains of potassium bicarbonate; add 1 ounce of water and 5 ounces of fresh cow's milk. Warm over a slow fire, and keep stirring until it becomes thick. Remove from the fire, stir for five minutes, replace it on the fire, and remove it as soon as it gets thick. As the starch is converted into dextrin and sugar by the diastase of the malt, it will become a thin and sweet liquid. Then, finally, boil it well. Strain through muslin.

This food is highly nutritious; besides the constituents of the milk, it contains predigested starch (dextrin and maltose) and the albuminates (gluten and albumin) of the wheat flour and the malted barley.

Foods composed (as some malted foods are) of malted flour and desiccated milk when mixed with water are defective as the sole food for children, as they do not contain the adequate proportion of fats, proteids, and salts; but these can be readily increased by the addition of a little cream or rich milk or some raw meat-juice. In preparing the various malted foods it is usual to bake the wheat flour, so as to render the starch-granules more soluble.

Mellin's and Nestlé's infant foods are examples of these malted preparations.

Pepsin, the proteolytic ferment of the gastric juice, acts only when in combination with an acid, and preferably hydrochloric acid. In contact with a dilute solution of sodium carbonate at the temperature of the body it is quickly destroyed, and it is also quickly destroyed by the alkaline secretions of the small intestine, aided by the action of the pancreatic ferment, trypsin.

Pepsin is rarely used for the preparation of artificial peptones or predigested foods, but it is largely given to promote the activity of stomach digestion in the stomach itself.

For this purpose many excellent preparations exist, but some are very uncertain and many probably quite inert.

Professor Chittenden of Yale University found the following remarkable differences in the proteolytic power of different pepsins:[1]

	Relative proteolytic action.
1. Parke, Davis & Co.'s Pepsinum Purum in Lamellis	100
2. Fairchild's Pepsin in Scales	52
3. Scheffer's Dry Pepsin Concentrated	48
4. Jensen's Crystal Pepsin	35
5. Boudault's Pepsin	14
6. Royal Chemical Company's Pure Pepsin	9

Pancreatin and Peptonized Foods.—We must again point out that the value of these preparations depend on their being *predigested* foods, and it would be an error to suppose that in administering them we are introducing an active digestive ferment into the small intestine; for the proteolytic action of trypsin is arrested in an acid medium like the gastric juice, and the gastric pepsin aids in the destruction of the ferment. "Hence, it is obvious that pancreatic extracts or ferments given by the mouth can be of no value whatever, since the proteolytic ferment at least will undoubtedly be destroyed in the stomach before reaching its normal sphere of action."[2]

If, however, as seems possible, the pancreatic extracts could be administered in capsules composed of a substance insoluble in dilute acid, but soluble in alkaline fluids, and be so conveyed unharmed

[1] *The Medical News*, Feb. 16, 1889.

[2] Prof. Chittenden on "Digestive Ferments," *The Medical News*, Feb. 16, 1889.

through the stomach to the duodenum, the difficulty would be overcome. *Keratin* appears to be a substance of this kind. Trypsin acts best in an alkaline medium, and pancreatic extracts are usually mixed with an alkali, but it is also active in a neutral medium.

Peptonized foods, strictly speaking, are artificially-digested albuminates, and might be made with pepsin and hydrochloric acid, as well as with pancreatic extract; but the latter is usually used, and when applied to foods containing carbohydrates or fats, as well as albuminates, its amylolytic and emulsifying properties also come into operation, and we obtain a very completely predigested food.

Pancreatin and the pancreatic peptones decompose very readily, and for this reason it is important in using them to be careful that no poisonous ferments are thereby introduced into the organism.

Meat-peptones are no doubt highly nutritious, but they are often of an unpleasant taste and odor: the smell of pure muscle-peptone is said by Zuntz to be very objectionable, and the more agreeably flavored preparations are said by Dujardin-Beaumetz to contain much comparatively useless gelatin-peptone.

This unpleasant odor and taste undoubtedly detracts from the administration of meat-peptones by the mouth, but it does not interfere with their employment in rectal alimentation, for which they are very valuable.

But many peptonized foods can be conveniently made for the sick-room as required by means of pancreatic extracts now readily obtainable.

The best of these are Benger's liquor pancreaticus, Benger's peptonizing powders, and Fairchild's *zymine*, a very convenient and active pancreatic extract introduced by Messrs. Burroughs & Wellcome, and supplied in air-tight glass tubes, each containing the exact quantity of pancreatic extract (5 grains) and sodium bicarbonate (15 grains) required to peptonize one pint of milk.

These pancreatin powders are very hygroscopic, and it is important that they should be kept in air-tight glass tubes.

Milk can be readily peptonized by these pancreatic extracts; the casein is converted into soluble peptones, and it thus becomes a most valuable food for delicate infants and others who cannot digest the coagulated casein of cow's milk. If, however, the milk be *completely* peptonized, it acquires a bitter taste which renders it unpleasant, and children will object to taking it; but if, as we shall describe, the process of peptonization be arrested at the proper time, and the milk be only partially peptonized (which, for other reasons, is an advantage), no disagreeable bitter taste is developed.

The method of peptonizing milk by means of Fairchild's peptonizing powders is very simple:

Into a clean quart bottle pour a pint of milk, add a quarter of a

pint of water and a tube of Fairchild's powder; shake them together. Put the bottle into water as hot as the hand can bear (about 150° F.), and let it stand for half an hour; then boil for two or three minutes.

It is then ready for use. It should be kept on ice or freshly made for each feeding. Boiling is for the purpose of permanently arresting the action of the ferment; cold will arrest it temporarily, and if kept covered with ice it is not necessary to boil it.

If the milk be allowed to stand longer than half an hour, peptonization will proceed too far and undesirable bitter products will be generated.

We can regulate the peptonization to any degree required, and we should be guided by the readiness with which the food is assimilated by the patient. For young bottle-fed infants a very slight degree of peptonization is often all that is required.

A teaspoonful or two of Benger's liquor pancreaticus and 15 grains of bicarbonate of sodium will answer equally well. The more completely we desire the food to be peptonized, the more, proportionately, of the digestive agent should be employed and the longer the process allowed to continue.

Peptonized milk gruel is also an excellent and valuable predigested food, highly commended by Sir William Roberts. It can be made as follows: A good thick gruel made with oatmeal or other meal, while still boiling hot, is added to an equal quantity of cold milk. The temperature of the mixture will then be about 140° F. To a pint of this mixture two or three teaspoonfuls of liquor pancreaticus and twenty grains of bicarbonate of sodium are added. It is kept at the same temperature for about two hours, and then boiled for a few minutes and strained.

In this mixture not only is the casein of the milk peptonized, but the starch of the meal is converted into sugar and its albuminates are peptonized.

The bitterness of the predigested milk is scarcely perceptible in this gruel.

Lean meat can also be readily peptonized by means of Fairchild's pancreatic extract or Benger's liquor pancreaticus:

If 4 ounces of finely-minced lean meat be added to half a pint of water, and then gradually brought to a boil, then half a pint of cold water added so as to reduce the temperature to about 140° F., and then thirty grains of Fairchild's zymine and twenty grains of sodium bicarbonate added, and the mixture kept warm for about three hours, the meat will be peptonized.

Peptonized beef-tea can be made in the following manner: Take half a pound of finely-minced lean beef; add to it a pint of cold water, and cook over a gentle fire till it boils. Decant the beef-tea into a jar or bottle, rub the meat into a paste, add it to the beef-tea, and mix in

another pint of water to reduce the temperature to about 140° F. Add a tablespoonful of liquor pancreaticus or sixty grains of Fairchild's pancreatic extract and twenty grains of sodium bicarbonate. Stand in a warm place for three hours, shaking occasionally; then boil quickly for two or three minutes, and strain.

This is a weak beef-tea, but it can be made of any strength required.

Following this method, various foods can be predigested or peptonized according to the wants and tastes of the invalids.

Bauer praises very highly Leube's meat-solution, as it contains, beside peptones, some unaltered albumin. It is made by exposing meat and diluted hydrochloric acid to a high temperature in air-tight vessels.[1]

Rectal Feeding.

It has been ascertained experimentally that soluble albumin, such as is contained in expressed meat-juice, is absorbed in the rectum to nearly the same extent as complete peptones; also that starch is converted into sugar and absorbed in considerable quantity; egg-albumin, when mixed with a small quantity of common salt, is also absorbed, but the mixture is too irritating to be suitable for enemata. Fat in emulsion also appears to be absorbed in the rectum. Solutions of peptones appear to be absorbed readily, but they must not be too concentrated or they prove irritating to the mucous membrane of the rectum, and they are then not retained. Expressed meat-juice and peptones seem, then, the most suitable foods for rectal alimentation. According to Bauer's observations, under no circumstances can more than *a fourth part* of the amount of nourishment necessary for subsistence be absorbed in the rectum from nutrient enemata, as its capacity is limited and the absorption of nutrient matters therein exceedingly slow.

Leube has pointed out the importance, if nutrient enemata are to be used for any length of time, of only employing substances that cannot cause the least irritation of the mucous membrane of the rectum, and that can be prepared without any great difficulty; and he has suggested enemata of meat and pancreas made in the following manner: Mince fine from 150 to 300 grammes of meat, and mix with from 50 to 100 grammes of finely-chopped pancreas, free from fat. Beat the mixture into a paste with a pestle or spoon, adding a little lukewarm water to make it of a suitable consistence for injection through the enema-tube. Use warm;

[1] 1000 grammes of lean meat minced fine are placed in a porcelain vessel with 1000 centigrammes of water and 20 centigrammes of pure hydrochloric acid. This is placed in a closed *Papin's* digester and boiled for ten to fifteen hours. The mass is then taken out and rubbed in a mortar to a paste. It is again boiled in the closed digester for another sixteen to twenty hours; after this it is neutralized with pure sodium carbonate and evaporated to a syrupy consistence.—Bauer: *Dietary of the Sick*, p. 88.

if cold, it may excite the rectum and cause expulsion. If thought desirable, from 25 to 50 grammes of fat may be intimately mixed with the mass by the help of a warmed pestle. A syringe with a wide nozzle must be used. Such enemata cause no irritation of the mucous membrane of the rectum, and can be retained from twelve to thirty-six hours. Evidence was also obtained by Leube that a considerable portion of the albumin and fat of such enemata is absorbed.

Peptonized milk gruel or peptonized beef-tea, mixed with some soluble carbohydrates, such as maltine or a mixture of one of the malted foods and peptonized milk, are useful preparations for rectal alimentation. Small quantities of wine or brandy may be added to such enemata when stimulation is indicated.

It is advisable to wash out the rectum with pure water an hour before administering a nutrient enema. Only a small quantity should be injected at a time—from 1 ounce to 3 ounces; a larger quantity is liable to be rejected. The tube should be well oiled to avoid setting up soreness or irritation at the anus, and it is well to use a long one, so as to inject the fluid as high up as possible, in order that it may come in contact with a more extensive absorbing surface. The addition of opium to the injection may ensure retention, but it may also retard absorption.

Peptonized suppositories are also prepared containing peptonized concentrated milk or meat, together with digested oil. These are said to have sustained life for weeks without exciting any rectal irritation. We have seen that it is impossible to maintain life for any length of time simply by rectal alimentation. If we have to trust to this alone, we can only avert death from starvation for a brief time, probably for two or three weeks. Not only is the amount of nutriment that can be absorbed by the rectum insufficient for the maintenance of life, but diarrhœa is extremely liable to set in after a time, so that the rectal injections are no longer retained.

As a temporary expedient it is exceedingly useful in all those cases in which there exists a mechanical impediment to the reception of food in the natural way; if this is not permanent, it may afford time for its removal, but if it is permanent it can only prolong life for a few weeks.

Rectal feeding is also a useful resource in certain states of the digestive organs in which they are intolerant of the presence of food, and in which it is desirable they should for a time be kept at rest—in cases of obstinate vomiting, of gastric ulcer, of acute gastritis, of diphtheritic paralysis, of spasmodic or other stricture of the œsophagus, as well as in the exhaustion of fevers, in delirium, and in other conditions which it is not necessary here to enumerate.

TUBERCULOSIS.

By SOLOMON SOLIS-COHEN, A. M., M. D.

Tuberculosis is a curable disease. Let us make this statement at the outset, though later we shall have to qualify it.

Confidence in the resources of the therapeutic art is a prerequisite to its successful exercise. Especially is this true in the treatment of a disease like that under consideration, in which so much depends upon minute attention to details and the co-operation of the patient is so important an element. If the physician lack faith in the utility of his efforts, he will neither give the necessary careful attention to individual peculiarities and to apparently petty matters of daily routine, nor inspire his patient with that hopeful and obedient persistence upon which the chance for a successful issue finally depends.

For these reasons let us fix our attention, in the first place, upon facts that shall give us courage and confidence—the numerous cases of healed tuberculous lesions recorded by pathologists and the unrecorded cases we have all seen in the dissecting-room and in the dead-house; the reduction shown in recent statistics of the mortality from tuberculous diseases, slight in some countries, greater in others; the occasional instances of recovery from acute and apparently tuberculous diseases which in former days brought in question the accuracy of the diagnosis—an experience that has come to many physicians;[1] the successful treatment, operative and non-operative, of diseases of glands, bones, and joints now known to be tuberculous; the recent successes of operative interference in tuberculous affections of the tongue, the larynx, the peritoneum; the many recorded cases of recovery from pulmonary phthisis in which the diagnosis has been undoubted, and the cases, not on record, of which we have personal knowledge. In the light of all these facts it must be admitted that a disease from which recovery occurs at times spontaneously, and at other times under various methods of treatment, is potentially a curable disease, and that every patient is entitled to the benefit of hopeful endeavor to render that potentiality in his case an actuality.

[1] McCall Anderson reports 5 recoveries out of 7 cases of acute phthisis: *British Medical Journ.*, Nov. 8, 1890.

From this standpoint, then, the disease and the methods proposed or employed to combat it will be viewed in the following pages.

Intelligent therapeusis must be based upon some consistent theory of the nature of the pathologic processes which it endeavors to combat. A few preliminary paragraphs must therefore be devoted to the explication of that theory of the nature of tuberculosis upon which is based the methods of treatment to be herein advised.

The majority of clinicians believed until recently that many different morbid processes were included under the term "tuberculosis," and hoped that the progress of knowledge would permit more accurate discrimination. The discovery of the *Bacillus tuberculosis* by Robert Koch, and the impetus given by that discovery and its fruits to the germ theory of disease in general, have caused opinions to be considerably modified. The accepted test of identity in diseases is now bacteriologic, as under the influence of the researches of Virchow and his school it had been histologic. In the subject under discussion, moreover, pathologists point out that not only are the minute tissue-changes upon which they formerly based the argument for identity of the various tuberculous processes virtually the same, but that these changes are the result of the invasion of the tissues by the same parasite—Koch's bacillus;[1] and they claim that thus the assurance of identity is now doubly sure.

Even if we grant the facts upon which this claim is based,[2] there remain still to be accounted for, the marked clinical differences long ago observed, and to-day recognized by all whose eyes see when removed from the microscope.

Each generation in medicine speaks a language of its own—a language that to its successors becomes a barbarous, and often an unintelligible, jargon. This will be the fate of the language of our generation as well; yet it has contributed to the progress of science many facts and some fancies that ought not to be lost. So, likewise, beneath the uncouth phraseology of past generations lie hidden much keen and faithful observation, much profound and philosophic reasoning, that we should be committing a grave error to ignore. The accumulated results of clinic experience, the views maintained from genera-

[1] The best concise presentation of the argument is Hilton Fagge's, *Practice of Medicine*, Philada., 1886, vol. i. pp. 84, *seq.*

[2] All pathologists do not concede the unity of the histologic processes, and some are still dubious as to the exact relation of the bacillus to these processes. The views of Virchow are too well known to need citation here. Shurly and Gibbes, *Am. Journ. Med. Sci.*, Aug., 1890, suggest a return to the older classification—*i. e.* acute miliary tuberculosis (of two kinds—neoplastic with few bacilli, and inflammatory with many bacilli), general tuberculosis (neoplastic with few bacilli), phthisis pulmonalis (inflammatory caseative with many bacilli), fibroid phthisis (sclerotic, sometimes inflammatory, and then with bacilli).

tion to generation amid the wreck of theories and the most significant revolutions in practice, are not to be lightly set aside. There were wise men before Plato. There were physicians before the days of the *rein-cultur* and the immersion-lens.

Let full weight be given to the results of the patient research and scientific acumen of the great investigators who have studied the morbid anatomy and the infectious agents of tuberculosis, but let us not ignore the many facts beyond the scope of laboratory and dead-house studies.

To make our conception of the disease sufficiently comprehensive we must include other elements than the bacillus and the changes in cellular structure or in chemic constitution of solids and fluids, brought about by its activity. There is in the constitution of the individual anterior to bacillary infection, something that determines the fact of infection,[1] and that largely determines, also, the course and character of the results of infection. We must not remain satisfied to cover our ignorance by naming this determining element "susceptibility," or, negatively, "lack of resisting power" to the bacillus; nor is it any advance to speak vaguely, whether figuratively or literally, of "favorable soil" and "good culture medium."

That condition which makes the human tissues a receptive "soil," a favorable "culture medium," for the tubercle bacillus—that condition which of old was called "diathesis," and now "susceptibility"—is itself a disease, a departure from the norm; and I believe it to be the most important element in the morbid complexus termed tuberculosis. It is the element requiring the greatest care in prophylaxis, the most intelligent and faithful treatment.[2]

A satisfactory term for this condition is difficult to find, for two reasons. In the first place, it is a negative and not a positive state—an absence, not a presence. To describe a hole is impossible, nor does a hole in the rocks differ from one in the sand. We must therefore indicate the nature of the deficiency by describing that which is wanting—that which is not there, but ought to be there. In the next

[1] This is generally admitted by partisans of the current doctrine. The object of emphasizing it here is not to put forth something new or original, but to deprecate the subordination of a primary etiologic factor to a secondary one. Our therapeutics must be largely influenced by the view taken of this question.

[2] It offers too the most eligible fulcrum for the application of the therapeutic lever. Flint in one of his latest utterances, while freely admitting the etiologic importance of Koch's bacillus, remarks, in paraphrase of Shakespeare, "You take away their lives when you do take away the means by which they live" (*Med. News*, Jan. 19, 1884). Writing in the light of many months' worldwide trial of "Koch's remedy," I see in the present resources of medicine no means of directly or indirectly destroying the bacillus or of preventing its destructive action, save by reinforcing the tissues. Nor do I conceive it within the range of probability that a "specific" against the disease will ever be discovered. If the broad view here taken of the morbid complexus be correct, the very idea of "specific medication" is irrational and misleading.

place—and this is the kernel of the difficulty—the present state of science does not give us an adequate term for what ought to be there. We have but an imperfect knowledge of the physical and chemic actions that go on in living tissues, and no knowledge whatever of the nature of that something more than physical and chemic action which converts these into vital processes.

That which is wanting in individuals who become tuberculous is the life-force, the vital energy—an energy which we know to exist because of its manifestations as fully as we know electric energy to exist; and physicians of the vitalist school may not be reproached with speaking of a form of energy they cannot explain, unless the same reproach is to be directed against physicists for the use of hypotheses involving electric energy.

To avoid periphrasis, and in the absence of an entirely adequate term, I shall, with Jaccoud, denote the condition here assumed as the fundamental factor in the production of tuberculous diseases by the word *hypotrophy*—defective nutrition. In so far as nutrition becomes in higher organisms largely a nerve-function, this view partially coincides with that of Holland and others, who look upon pulmonary consumption as a neurosis.[1] But inasmuch as nutrition remains also extra-nervous, the neurotic hypothesis is too narrow.

As our hopeful therapy is to be directed against hypotrophy, we must endeavor to gain as clear an understanding of it as our knowledge of vital processes will permit. It will therefore be discussed from different standpoints.

Hypotrophy.—Hypotrophy is a defect in the constructive or tissue-building powers of the organism. It has, doubtless, morphologic[2] and

[1] See paper by Mays, *Therap. Gaz.*, Nov. and Dec., 1888.

[2] The gross morphology of so-called "scrofulous types," to be considered farther on, is not here referred to. Brehmer (*Die Aetiologie der Chronischen Lungenschwindsucht*, Berlin, 1885, pp. 143, *et seq.*) reaffirms the observation of Rokitansky that in phthisis patients there is a relative incapacity of heart, vessels, and abdominal viscera to lungs which are abnormally long. Beneke (*Die Anatomische Grundlagen der Constitutionsanomalien des Menschen*, Marburg, 1878) gives elaborate statistics. B. W. Richardson (*The Asclepiad*, 1888, No. 20, vol. v. p. 330) discriminates sharply between the quality of "strong vitality" and the power of "immediate resistance to acute diseases and accidents." He believes the former to reside not in "super-endowment with a principle of life," but in the nice proportion of the organs of the body one to the other, the organs of vegetative life especially being of good mechanic construction and adaptation, and the general harmony being equably maintained. My own clinic observation coincides so far with Brehmer's that I find a large proportion of cases exhibiting the "phthisical habitus." Formad (*Philada. Med. Times*, vol. xiii. p. 109) claims that a generally embryonal type of tissue, with narrowing of lymph-spaces, is characteristic of the scrofulous animal. Allusion may also be made to the observations of Salisbury and Cutter on the blood, honestly reported, but dubious of interpretation. I have thought I observed in the blood of phthisis patients disintegration of leucocytes and deformity of red cells. In many febrile cases there have been a richness of blood-plaques (?) and tendency to rapid fibrillation, apparently with the plaques (?) for cen-

chemic correlates,[1] but our knowledge concerning these is very imperfect. It may be congenital or acquired, and varies much in degree in different individuals, or even in the same individual at different times. Being a defect in the reserve store of potential energy, it is ordinarily not manifested until the occasion arises to transmute potential into actual energy; and it then becomes evident chiefly as a lack of reparative force. Thus its histologic expression is the formation, in the place of normal tissue-elements, of tissue-elements of degraded type and low vitality.[2] A distinguishing feature of the retrogressive course of such tissue-elements is a lack of tendency to organization by the production of blood-channels[3] in their aggregations. Tubercle, the morbid cell-aggregation produced under certain conditions by hypotrophic organisms, differs thus, both from inflammatory new-formations and from neoplasms, which are evidences either of an abnormal excess of tissue-building power or of perversion of normal tissue-building power. Further, inflammation is a process that tends to termination, whether by resolution or by suppuration, and finally to repair. Neoplasms acquire a certain degree of organization, develop blood-channels, and tend to persistence. The tuberculous process cannot with certainty be said to tend either to termination or to persistence. On the one hand, there is in caseation the evidence of a tendency to termination by destruction, without subsequent repair. On the other hand, reticulation and cicatrization (?) seem to give evidence of a tendency to termination by organization, with persistence of reparative

tres. The same thing, however, occurs at times in typhoid and in surgical fever. In a recent case at the Philadelphia Hospital, which exhibited during life symptoms of Graves's disease (tachycardia, intermittent thyroid enlargement, gastric crises) and other neurotic disturbances, the necropsy showed enlargement and hardening of the cervical ganglia and of the semilunar ganglia, and enlargement of portions of the pneumogastric. Microscopic examination is not yet completed.

[1] Glover (*Pathology and Treatment of Scrofula*, London, 1846, pp. 92, *et seq.*) quotes earlier observers, and relates that he found, apart from the deficiencies common to anæmic states, an increase of the solids of the blood-serum in phthisic and scrofulous persons. Freund (*Wiener med. Jahrb.*, abstracted in the *Med. News*, Jan. 21, 1888, p. 83) prepared a substance resembling cellulose from the blood of tuberculous cases and from tuberculous growths. He also determined an increase of potassium salts, with diminution of sodium salts and of phosphoric acid, in the blood. Quinquaud (*Comptes-Rendus Congrès pour l'Étude de la Tub.*, 1er fasc. p. 443) found a progressive diminution in the amount of sugar in the blood of the tuberculous. Buchner's researches on the bactericide substances in blood-serum, which he concludes to be salts, are of interest in this connection (*Centralb. f. Bakter.*, 1889, Bd. vi. p. 361). Roger and Charrin (cited by Byers, Keating's *Cyclopædia of Dis. of Children*, vol. iv. p. 355) found blood-serum impoverished.

[2] "One of the first tendencies of this habit is to the formation of tissues of an inferior degree of animilization, among which I class tubercles" (Graves, *Clinical Medicine*, Dublin, 1843, p. 279).

[3] Is there some fundamental connection between this and the relative vascular incapacity demonstrated by Rokitansky, Louis, Brehmer, and Beneke?

tissue. Recent experience with "tuberculin" would seem to show, however, a low vitality of this fibrous tissue in certain subjects, as evidenced by its readiness to break down under the attack of that poison. Spontaneous hyaline degeneration is another evidence of this feeble vitality. Calcification, again, is somewhat of the nature of a reparative process that may take place even after caseation.

But the histogenesis and progress of the various elements of tubercle are involved in so much doubt that no more accurate definition than the one we have attempted could be defended. Many factors yet unknown must modify greatly the course of the process in different organs and in different individuals.

When, in the course of ordinary wear and tear or of extraordinary wear and tear, or following inflammation or injury, or from any cause or combination of causes, degraded tissue-elements have been produced, it is highly probable that the tubercle bacillus and other microbes,[1] finding therein a "favorable soil," modify by their activity the further evolution of the disease.

Microbes, apparently pathogenetic, are constantly gaining admission into the body in the respired air, in food, and by other channels. To guard against their entrance by every possible precaution is wise; and the best means to this end will be considered in an appropriate connection. Here, however, it is desired to emphasize the facts that *independently of the invasion of the microbes associated with tuberculosis there is a disease to be treated*, and that if this disease be successfully treated the microbes will come and go harmlessly. If the defences on the frontiers are kept in order, the enemy cannot penetrate into the country.

Hypotrophy, then, is not only in itself a disease, but it renders the subject liable to various epiphenomena of a morbid nature, some of them far more serious than the condition upon which they have been superimposed. Nevertheless, hypotrophy continues to be the fundamental disorder, for without its continuous co-operation the other morbid processes cannot maintain themselves; and if it can be therapeuti-

[1] Malassez et Vignal, *Arch de Phys.*, iv., 1884; Charrin et Rogers, *Comptes-Rendus Acad. des Sciences*, 1888, p. 863, *et seq.*; Cornil et Toupet, *C. R. Cong. de la Tub.*, 1er f. p. 455; Grancher et Ledoux-Lebard, *Arch. de Med. expérimentale*, tome i., Paris, 1889, p. 203, *et seq.*; tome ii., Paris, 1890, p. 590.

For recent studies of the association of other microbes with the tubercle bacillus, see Solles, *Comptes-Rendus Congrès pour l'Étude de la Tub.*, Paris, 1889, 1er fascicule, p. 438 et p. 563; Babes, *ibid.*, p. 542 et p. 561.

For a recent study of the late association of Koch's bacillus with tuberculous lesions see Gibbes, *Am. Journ. Med. Sci.*, March, 1890; Hamilton's case (*Textbook of Pathology*, vol. i., London, 1889, p. 419) is in point. The absence of bacilli from recent tubercles in patients dead of "Koch's remedy" (Guiteras, *Univ. Med. Mag.*, March, 1891) is a fact worth considering. Cornil et Toupet, *op. cit.*, p. 454, report a case of local "pseudo-tuberculosis" in man from irritation by a fragment of oyster-shell.

cally overcome before destruction has gone too far, recovery may be confidently anticipated. Practical expression of this same prognosis, though without reference to its theoretic basis, may be found in the words of Laennec:[1] "La guérison dans les cas de phthisie pulmonaire où l'organe n'a pas été entièrement envahi, ne presente, ce me semble, aucun caractère d'impossibilité ni sous le rapport de la nature du mal, ni sous celui de l'organe affecté."

It is important, from a therapeutic standpoint, to consider hypotrophy somewhat more fully in its relations with the vital energy. To avoid extended digression I shall do this somewhat more dogmatically than I would prefer, and in the merest outline, ignoring many details of great importance to physiology, but requiring more space than can be spared in this preliminary study.

The term "vital energy," or *bionergy*, may be fitly applied to that power resident in living substance (Beale's bioplasm) which enables it to transmute physical and chemic actions into vital processes, and to transform inanimate matter into the material basis of life. Like all other forms of energy, it has both potential and kinetic modes. Kinetic bionergy has its positive (*i. e.* discharging, kinetizing) and negative (*i. e.* accumulating, potentializing) phases, which we term respectively katabolism and anabolism.[2]

Anabolic energy finds its material correlate in tissue-building, and anabolism is thus virtually coextensive with assimilation, development, the constructive phases of reproduction, growth, and nutrition. Katabolic energy is the dynamic correlate of destructive tissue-changes, and katabolism is thus practically coextensive with dissimilation and function. It must not be confounded with retrogression or decay, which are evidences either of defective anabolism or of unavoidable waste.

At whatever point we cut the wire joining the two elements of an electro-chemic cell, we produce by that division *anode* and *kathode*. When we again complete the circuit, anode and kathode disappear. In the same way *anabolism* and *katabolism* form a continuous process, which we divide for convenience in study. They are everywhere connected, and every phase of cellular activity has its anabolic as well as its katabolic—its katabolic as well as its anabolic—side. While for our purpose it is simpler, and, considering our very limited knowledge of the intricate nature of the processes, fairly correct, to look upon the two phases of bionergy not only as reciprocating, but as

[1] *Traité de l'Auscultation médiate et des Maladies des Poumons et du Cœur*, Paris, 1826, tome i. p. 641.

[2] Without desiring to make that author responsible for any part of the views here put forth—which are not new except in terminology—no one can write of the relations of anabolism and katabolism without making acknowledgment to Gaskell for his instructive researches.

alternating conditions, it must not be forgotten, then, that they form in some respects a closed circuit and are therefore coincident; and that their apparent opposition is relative only and due to the necessities of the human mind, rather than to sharp limitations in nature.

There may be thus distinguished three modes of vital energy—*Potential Bionergy* and the two kinetic phases, *Anabolergy* and *Katabolergy*. These are now to be briefly considered in respect to their origin, site, quantity, and distribution.

With the *ultimate origin* of bionergy we have only to do so far as to recognize that it is a mode of universal energy, and mutually interconvertible with the other modes. If deficient, it may therefore be therapeutically reinforced. If entirely exhausted, however, it cannot be reproduced. The secret of the conversion of other forms of energy into life-energy, God has not revealed. It is to be studied, nevertheless, as light, heat, electricity, and chemic action in relation to the doctrine of the correlation of forces or conservation of energy.

The *immediate origin* of bionergy in any living cell produced at the present stage of universal evolution is the transmitted energy of the parent cell.[1] *Omne vivum ex vivo.* The *site*, or material correlate, is the bioplasm or living substance. The *quantity*, in the first instance, is that given by the parent cell. *Distribution* being represented by a closed circle, we will begin with the potential state. Disregarding that very obscure manifestation of anabolic preponderance which follows impregnation, and taking for study the simplest type of animal life,—a cell born with a certain quantity of potential bionergy, represented by its molecular constitution and motion, immediately begins the performance of certain vital functions (*e. g.* respiration, secretion, cell-digestion), transforming potential energy into the kinetic energy of katabolism. In order that life may be maintained, this loss of energy, correlated with change in molecular constitution and motion, must be compensated. This is accomplished by the further conversion (indirectly) of katabolic energy into anabolic energy; which, by restoring, in the elaboration of the products of digestion, the previous molecular constitution and motion, renews the store of potential energy. Anabolergy and katabolergy may thus be termed *circulating energy*[2] as contradistinguished from potential or *reserve* energy. The two forms of circulating energy, which act upon external forces and materials derived from without, must balance one another, in order that potential energy, expended by one and renewed by the other, may remain unimpaired.[3]

[1] My friend, Dr. Geo. M. Gould, suggests the terms *cytolergy* and *cytolysis*.

[2] This conception, while it best answers, through its simplicity, to illustrate our present theme, is not exact, and some modification of it will appear when we consider the subject of diet.

[3] There is, however, a small, variable, but on the whole continuous loss, comparable

It may reasonably be assumed that in a cell possessing a normal quantity of original energy (*orthotrophy*) the circulating energy never represents that full normal quantity. There is a large reserve of potential energy by which katabolism may be kept up, not indefinitely, but for more or less prolonged periods when necessary, without renewal through anabolergy. In the early periods of a cell's history, when it is possessed of its largest store of potential energy, and anabolergy therefore exceeds the mere needs of katabolergy, it exhibits, in addition to function and repair, the phenomena of growth ; but finally it comes into a state of completed growth, when its energies are manifested by function and repair only. After a certain period of growth, reproduction takes place. Then development arises from modification of reproduction. Development involves great loss of potential energy, and deficiency of original energy necessarily produces in species, races, families, or individuals an imperfect, unbalanced development, the antithesis of that "nice proportion of organs" in which Richardson[1] finds the secret of long life. But into these questions we can only peep.

The problem of hypotrophy in man has respect to the quantity of original energy, and to the relations of katabolergy with anabolergy, and of both these with potential bionergy. *Congenital hypotrophy* depends upon a quantitatively deficient inheritance of original energy. *Acquired hypotrophy* depends upon an excess of katabolergy or a deficiency of anabolergy, reducing the quantity of potential bionergy below that inherited. The congenitally hypotrophic is born to an impaired patrimony. He who acquires hypotrophy is either a spendthrift or one robbed of his possessions or deprived of his rightful opportunities. A cell congenitally hypotrophic may fail, if the deficiency be great, to reach its full or perfect development or growth.[2] If the deficiency be less, the cell may exhaust its potential energy in the process of development or growth, and be unable to maintain its life ; or it may, in a more or less imperfect fashion, and so long as the two phases balance, maintain its life through the circulating energy furnished by materials and forces from without, but break down under any condition causing a relative excess of katabolism ; or it may be able to withstand a slight excess of katabolism, but break down at the period of reproduction.

to friction in a machine, which we may term decay (not putrefaction, which is a result of the action of microbes on decaying tissues), and which finally results, in higher organisms at least, in natural death. The Protozoa, it is said, are immortal.

[1] *Loc cit.*

[2] La Torre (*C. R. Cong. pour l'Étude de la Tuberculose*, f. i. p. 489, *et seq.*) gives clinic facts showing the influence of paternal tuberculosis in arresting the development of the fœtus. The tendency of tuberculosis and the tuberculous and syphilitic diatheses in either parent to produce abortion and stillbirth is a matter of common knowledge.

Cellular reproduction, variously modified, is the basic phenomenon of the development of the embryo and of the growth of the child. Of reproduction of tissue-cells in the adult under normal conditions we know too little—except in the case of epithelium—to speak with positiveness; but it is in the highest degree probable that physiological wear and tear involves natural death of all forms of tissue-cells and reproduction of other cells in repair. In the case of blood-cells, this is almost certain. In repair of wounds and in the processes of inflammation, reproduction is confessedly one of the most prominent phenomena. Orthotrophic cells are able either to reproduce their kind in repair or to form a durable scar-tissue. Hypotrophic cells produce a degraded embryonic tissue, or, rather, a progeny of cells so deficient in potential energy that they cannot complete their development into tissue. They form a mass of feeble elements unable to progress either into the parent type or into what may be termed physiologic cicatrix-cells; in other words, tubercle.[1] Tubercle-cells being deficient in vitality and tuberculous masses being devoid of vascularization,[2] it is not difficult to explain caseation, or at least necrosis, even without bacillary intervention; while the well-known facts of the nutritive relations between dying organic matter and bacteria, will sufficiently explain the nature of the "favorable soil" presented for these organisms. Bacterial development gives rise to certain toxic products, which in turn produce new lesions and dynamic disturbances.

Such, in brief, is the theory of tuberculosis upon which we shall endeavor to build a rational therapeusis. It is not offered as the whole truth, but as an adumbration of the truth. It is believed to be consistent in itself and not opposed to any demonstrated fact.

Causes of Hypotrophy.—Let us now briefly consider, in order that we may learn to avoid them, the conditions that may give rise to hypotrophy. Bioplasm and bionergy being inseparably connected, we shall not in every instance speak both of energy and of matter,—but of one or the other as may be more convenient; their correlated changes of state being assumed throughout. Given an organism possessing a normal quantity of original energy, it may partially or wholly exhaust its reserve store, either through *deprivation* of material for con-

[1] That the bacillus is not necessary to the production of the histologic tubercle is shown not only by a host of early observations (*vide* Waldenburg, *Die Tuberculose, etc.*, Berlin, 1869), but by the very recent example of local "pseudo-tubercle" in man following a wound with an oyster-shell, reported by Cornil et Toupet (*C. R. Cong. p. l'Ét. de la Tuberculose*, f. i. p. 453).

[2] The relation between cell-vitality and the production of fluids is extremely important and extremely obscure. It seems a characteristic manifestation of bionergy in fitting complex metazoa for the maintenance of particulate and general life. The intercellular substances and the circulating fluids are alike integral parts of the tissues, results of the katabolergy of cells and indispensable instruments of anabolergy.

version into force to meet current expenditure or through *excess* of current expenditure over power of reaccumulation. The terms are of course relative, a certain normal standard being assumed.

There are also certain direct causes of hypotrophy apparently independent of either excess or privation—forces that seem to antagonize and partially prevent both the conversion of potential bionergy into katabolergy and its reaccumulation through anabolergy: these we will call *depression*.

Depression, privation, and excess are the recognized causes of hypotrophy. The terms are self-explanatory. Under the head of *depression* we include psychic factors principally—*i. e.* grief, disappointment, fear, shame, anxiety, shock, religious[1] gloom and terror, and similar influences. Under the head of *privation* we include want of proper food, want of air, want of light, want of heat, want of cleanliness, want of clothing, want of shelter, want of enjoyment, and the like. The effect of privation as a factor in the causation of tuberculosis is daily manifest; but if experimental evidence be preferable we have the results obtained by Jenner and Baron and by Carmichael[2] among earlier observers, by Brown-Séquard[3] and by Trudeau[4] among living observers, to show it both positively and negatively. The experiments of Canalis and Morpurgo as to the influence of starvation in reducing the resistance to infection are likewise in point. The effects of indigestion are included in the category of want of food, as impure air, crowding, and other unhygienic conditions are included in other categories of privation. Under the head of *excess* we include dissipation, particularly sexual excess; over-eating and over-drinking; overexercise; exhausting or unresting labor, physical or mental; prolonged lactation, lactation continued during pregnancy; too frequent and rapidly succeeding pregnancies; the effects of various forms of disease (*e. g.* typhoid fever, measles, influenza, diabetes); and violent or consuming emotions, rage, jealousy, greed, inordinate ambition, and the like. These causes are of different potency, and their effect varies according to their degree and according to the duration of their action. Very often several of them are combined. They affect an organism congenitally hypotrophic more quickly and more intensely than one congenitally orthotrophic. As was clearly recognized by Lugol,[5] an individual exposed to one or more of these influences may escape the overt mani-

[1] In Laennec's celebrated instance of the French religious order (*op. cit.*, p. 647) there can be little doubt that depression had much to do with the extinction by phthisis of all the nuns save those whose duties kept them in contact with the outer world.

[2] *An Essay on the Origin of Tuberculous and Cancerous Diseases*, Dublin, 1836, p. 5.

[3] 1869, cited in the *N. Y. Med. Journ.*, Dec. 24, 1887.

[4] *Med. News*, Oct. 27, 1888, p. 466.

[5] *Récherches et Observations sur les Causes des Maladies scrofuleuses*, Paris, 1844, pp. 80, *et seq.*

festation of disease in his own person, but be unable to procreate offspring of normal vitality. Other conditions, affecting one or both parents, which may determine *congenital hypotrophy* of the offspring,[1] are—an unfavorable age for procreation, whether too young or too old; too great disparity between the ages of the parents, more especially if the wife be older than the husband (Lugol); a relative lack of vigor in the husband compared with the wife (Lugol); too rapid procreation (affecting the younger offspring injuriously); acquired or congenital, temporary or permanent, latent or overt hypotrophy; existing tuberculous[2] or other disease (especially neuroses, syphilis (Lugol), and carcinoma[3]); privation, exhaustion or depression affecting the mother during pregnancy. The importance of these factors has long been well recognized by clinicians, and was clearly taught by Beddoes, as also by Carmichael,[4] despite his curious parasitic theory of disease. As to consanguinity of parents, on which the last-mentioned author lays great stress, the weight of testimony seems to be that it will increase the potency of other causes, but in itself, unless long continued from generation to generation,[5] will not produce hypotrophy. That not only hypotrophy, but actual tuberculosis, may be transmitted from either parent to the child was well known to the older writers, who had seen tubercles in the fœtal organs; and the correctness of their statements can no longer be doubted, even by the most strenuous partisans of contagion, in the face of the recent observations of Johne[6] and of Jacobi,[7] the researches of Landouzy and Martin,[8] and the additional case of Birch-Hirschfeld.[9]

I hold, then, that hypotrophy, congenital or acquired, is the starting-

[1] Lugol, *loc. cit.*; Brehmer, *Die Aetiologie der Chronischen Lungenschwindsucht*, Berlin, 1885, p. 173, *et seq.*

[2] Some recent pertinent observations are those of Ferrand, *C. R. Cong. de la Tuberculose* f. i. p. 486, *et seq.*; Solles, *ibid.*, p. 532; Bang, *ibid.*, p. 536.

[3] For a recent study see Ricochon, *C. R. Cong. pour l'Étude de la Tub.*, f. i. p. 493, *et seq.* My own experience shows, at all events, *a close association* between carcinosis in the parent (more particularly the mother) and tuberculosis in the children.

[4] *Op. cit.*, p. 51.

[5] Brush, *N. Y. Med. Journ.*, June 28, 1890, p. 708.

[6] Johne found tuberculosis in the lungs and liver of the fœtus of a cow dead of pulmonary tuberculosis, although he failed to find evidence of the disease in the uterus or placenta. Cited by Baivy, *La Tuberculose, etc.*, Louvain et Paris, 1890, p. 103. (See also Firket, *Revue de Méd.*, Jan., 1887.)

[7] Jacobi (Keating's *Cyclopœdia of the Diseases of Children*, vol. ii., Philada., 1889, p. 167) found miliary tubercles in the liver, spleen, and pulmonary pleura of a seven-months' fœtus that lived but a few minutes after delivery. The mother belonged to a consumptive family, had herself suffered with consumption before marriage, and died three weeks after confinement. The father was healthy.

[8] *Comptes-Rendus Congrès pour l'Étude de la Tuberculose*, f. i., Paris, 1889, p. 483, *seq.*; *Études expérimentales et cliniques sur la Tuberculose*, Paris, 1887, t. i. p. 59, *seq.*

[9] *Beitrage zu Pathologischen Anatomie und zu Allgemeinen Pathologie*, 1891, p. 429, cited in *Revue de Méd.*, 1891, No. 5, p. 431.

point of the various morbid processes now, for want of better knowledge, indiscriminatingly called tuberculous; and that the bacillus of Koch, while it is perhaps the most important of several microbes that influence the progress of the lesions in various forms of the disease, does not of itself originate the disease in any form. It is further taken for granted in these pages that tuberculosis is not one disease, but a group of diseases; the group being composed of a number of forms more or less intimately related, and including, moreover, the *pseudo-tubercle* produced by Lebert, Fox, Sanderson, Formad, and others[1] in their experiments with indifferent substances upon certain animals known to be especially liable to tuberculosis, and that may therefore be termed, in comparison with others, "normally hypotrophic."

If pathologists could give us criteria by which to distinguish more certainly these various forms, we could formulate more definitely our prognosis in individual cases, and likewise determine why some forms are readily curable, others curable with difficulty, and others, perhaps in truth, incurable. The actual relations of the bacillus with the disease would become clearer, and might assist in the prognostic classification. In the present state of our knowledge we must look to the relative degrees of hypotrophy as the most plausible explanation of the different degrees of curability. But much research and much patient sifting of the results of research will have to be done before we can generalize with assurance, and before we can determine the true part in pathogenesis taken by microbes and by the products of their activity.

While, therefore, the different diseases now grouped by pathologists under the heading of "tuberculosis" have a common starting-point, and much in common in their development, they may also exhibit considerable variations according to the particular part played by the various etiologic factors; and clinicians in their systematic classifications are bound to recognize and discriminate the more marked varieties.

Therapeutically, we have first to distinguish broadly between *chronic localized tuberculosis* and *acute disseminated tuberculosis*.

From the former we can often help to bring about recovery; against the latter we must still confess ourselves almost powerless.

In the former there is to be recognized a tendency to reaction of the organism, limiting the process both in time and in space. Fibroid changes occur in the tuberculous nodules, and the disease would come to an end save for persistence of the cause, leading to its development in new areas. Extension of the process to new areas is, however, slow and restricted. The excretory organs are competent to deal with the comparatively small quantities of poisonous substances developed

[1] List cited by Formad, *Philadelphia Med. Times*, Nov. 18, 1885, reprint, p. 33.

by the breaking down of tissue, and systemic intoxication is for a long time slight or absent. In these cases judicious therapy may confirm the tendency to cicatrization and help to prevent extension. This is cure.

In acute disseminated tuberculosis the tendency to limitation by reaction is wanting; the infection becomes rapidly and widely distributed, and the process does not eventuate in cicatrization, but in degeneration or necrosis. In addition, in some forms of this disease the rapid breaking down of tissue, possibly conditioned by bacterial activity, fills the circulation with one or many poisons[1] belonging to the group of (toxic) metabolins,[2] thus adding to the morbid complexus toxæmia or septicæmia. These and other pathologic processes act and react in a vicious circle, or, more accurately, interlacement, and the organism almost inevitably succumbs.

I cannot avoid the conviction that better knowledge will enable us to discriminate between these two processes etiologically, both as to exciting causes and predisposing causes. Accepting them, however, for the present, as two forms of one disease, we recognize further a variety of gradations between them.

There are both acutely beginning and insidiously beginning processes that with little or no tendency to limitation in time, yet remain for prolonged periods more or less limited in space. In some of these cases the diseased tissue may be removed and a cure thus effected. In other cases, where such removal is impracticable, the constitution may be so fortified that the disease remains local, though it does not come to an end.

There are both insidiously beginning and acutely beginning processes, that show comparatively little tendency to limitation in space, yet a great tendency to limitation in time. Serious ravages may be committed, yet the disease come to an end before the damage is fatal. Particularly in pulmonary phthisis do we find this type mingled with the type first described; and a patient may survive several such outbreaks.[3] The chances for survival are greater the farther the successive outbreaks are removed from one another in time and the less removed they are from one another in space; though to this latter statement certain qualifications must be made, which can be more appropriately considered later on.[4] Further, there are processes of all the kinds

[1] See R. W. Philip, reported in *Med. News*, Sept. 24, 1887, p. 373; ibid., *Brit. Med. Journ.*, Jan. 28, 1888; B. W. Richardson, *The Asclepiad*, vol. vi., 1889, p. 35; Robert Koch, *Deutsch. med. Woch.*, Nov. 13, 1890.

[2] By the term *metabolin*, Gould proposes to denote ptomaïnes, leucomaïnes, toxines, etc., etc.

[3] *Vide* Forbes's *Laennec*, London, 1834, p. 329.

[4] I have at this writing under my care a woman with chronic phthisis of many years' duration, with a moderately large cavity in the right lung, in whom three

enumerated which clearly begin as tuberculosis, and others which apparently begin as acute or chronic non-tuberculous inflammations.

If, then, tuberculosis is, as we believe, a morbid process which can take place only in certain individuals, because in these individuals there is a lack of nature's protective force (*vis medicatrix naturæ*), it becomes evident that the most important measures in combating the disease are those of prophylaxis.

Prophylaxis.—This begins before conception. Lugol, quoting Fernel, exclaims, "Maxima ortus nostri, vis est." Oliver Wendell Holmes characteristically puts it that one "ought to be very careful in the selection of his ancestors." Certain it is that persons of inherited taint or persons debilitated from any cause, or rendered by age, disease, or other condition unfit to generate normal offspring, ought to be very cautious how they become ancestors.

The advice of the physician is sometimes sought—would it were more often!—as to the advisability of marriage, and he owes a duty both to his patient and to society to inform himself fully as to all the facts, and to advise against marriage should the facts demand that advice. Jaccoud[1] would prohibit the marriage of persons "affected by the debility that precedes tuberculosis" in case no preventive treatment had been adopted, or if such treatment had failed to bring about the desired constitutional change, and in all cases of hereditary origin even if the result of preventive treatment had been satisfactory. He has observed marriage in such cases transform virtual into actual disease; both parents and offspring suffering in consequence. When, however, treatment has produced complete constitutional change and no hereditary taint exists, marriage may be permitted without reservation so far as the male is concerned, but not without some doubt as to the female, on account of the possible deleterious effects to the mother of repeated pregnancy. "When consumption is hanging about a girl," says Beddoes,[2] "the distance between the marriage-bed and the grave is usually short with her. The husband, if he do not become a widower soon after the birth of the first child, may reckon upon a perpetually ailing wife."

The circumstances of each individual case will necessarily largely govern the decision; hence no general law can be laid down. In any case, when such a marriage occurs the mother should not be permitted

threatening attacks of acute softening have been confined to the one region, so far as auscultation gives evidence, and have resulted either in enlargement of the one cavity or in the formation of a number of small cavities in close proximity. She has recovered in a comparatively short time in each instance.

[1] *The Curability and Treatment of Pulmonary Phthisis*, translated and edited by Montagu Lubbock, London, 1885, p. 101.

[2] *Hygeia, or Essays, Moral and Medical, on the Causes affecting the Personal State of our Middling and Affluent Classes*, Bristol, 1802: "Essay VII., On Consumption," p. 95.

to suckle her children, for prolonged lactation may bring about the conditions favorable to the development of phthisis, even in the absence of hereditary predisposition.

We have already enumerated other factors that may produce congenital hypotrophy, and, were procreation regarded as it should be by men, these would be avoided. Presuming the health of the parents and the conditions surrounding the procreative act to have been all that they ought to be, the mother should be properly guarded and nourished during pregnancy; and this is of course still more important when her health is known to be other than normal.

After birth the main elements of prophylaxis are two: 1. To add force to the organism; 2. To avert infection. As the latter division of our theme may be treated with comparative brevity, systematic presentation of the whole subject will be facilitated by taking it up first. Before doing this mention must be made of a third element of prophylaxis. The consideration of this, however, is so intimately interwoven with that of both the others that the simple statement must suffice for all separate study of it. It is protection against exciting causes of catarrhal or other pulmonary or intestinal disease. In relation with phthisis especially, is protection against "colds" advisable. However, as Jaccoud well says, "fortification against attack is even better than protection" from exposure.

Avoidance of Infection.—The contagiousness or non-contagiousness of tuberculosis is a moot question, into the *pros* and *cons.* of which we will not here enter, nor will we refer to its extensive literature.

My own opinion, based both upon reading and upon personal experience, is that there is no such thing as transmission of tuberculosis by contagion in the ordinary acceptance of the term; but that the products of the disease are infectious, and when introduced into the respiratory or digestive passages, or otherwise gaining entrance into the tissues or circulation, of a hypotrophic subject, may set up active morbid changes. Infection is more probable when a wounded,[1] abraded, or inflamed surface offers a *locus minoris resistentiæ.* In such cases the morbid process may remain local or the disease may become general. When an orthotrophic subject is thus infected, the process is likely to remain local and healing soon take place. The "anatomists' tubercle" is an example.

While I cannot endorse all the stringent police regulations that have been suggested by extreme partisans of the theory of contagion, I am heartily in favor of such reasonable measures as will tend to secure the destruction of noxious matters and to ensure the purity and wholesomeness of food-supplies.

[1] Laennec, *op. cit.*, p. 649.

FOOD.—We have already seen that a tuberculous mother should not nurse her child. Precaution as to the wet-nurse is no less necessary. Infection through the milk, or otherwise in the process of nursing, is a demonstrated possibility.[1]

Jaccoud believes the same danger to exist if either of the parents is tuberculous, and would therefore prohibit suckling by the mother, even should she be healthy and the father be the subject of disease.

The undesirability of the milk of tuberculous kine as an article of diet is evident, quite apart from its possible contamination with bacilli or infectious principles.[2] To prevent as far as possible dangers arising from such contamination, milk should be boiled. "None but savages," says Jacobi, should "drink raw milk." J. Lewis Smith[3] cites the "remarkable statement of Voelsch that twice boiling does not entirely destroy the virulence of the tubercle bacillus." He directs that the morning supply of milk "shall be immediately placed in a steamer and subjected for two hours to a temperature of 190° to 200° F."

To ensure both the non-tuberculous nature of milk and its possession of due nutritive quality there should be an efficient system of sanitary inspection at the points of production, of transportation, and of distribution. The milk of stall-fed animals, even when they are well fed, is far inferior to that of those leading a natural life in the open air. Brush[4] has forcibly stated the objections to the milk of closely-inbred cattle. Goat's milk is free from many of the dangers of cow's milk, and those using it are said to soon become accustomed to it. The solipedes are especially refractory to experimental tuberculosis, and spontaneous tuberculosis is almost unknown among them. This may explain the virtues of ass's milk and mare's milk, which were prescribed by Hippocrates, Celsus, Galen, and other ancients,[5] and are highly recommended by modern French authors. On the whole, however, I see no danger in the milk of healthy cows permitted to graze in season and at all times properly cared for. As before stated, all milk used for food purposes should either be sterilized by the dairyman or boiled immediately after receipt by the consumer. It should be kept covered from the air. The flesh of tuberculous animals should not be permitted to be exposed for sale. Whether or not we agree to the propriety of destroying all tuberculous animals—and I would advocate that measure from my own point of view, without reference to the contagion theory—it is self-evident that

[1] Niepce, cited by Lannelongue, *Étude expér. et clin. sur la Tuberculose*, f. i. p. 90; Ricochon, *C. R. Cong. de la Tub.*, f. i. p. 527.

[2] A good summary of various observations as to infection by the milk of tuberculous cows is given by Woodhead: *Reports from the Laboratory of the Royal College of Physicians*, Edinburgh, 1889, vol. i. p. 186, *et seq.*

[3] *Med. News*, Dec. 14, 1889. [4] *N. Y. Med. Journ.*, Mar. 24, 1888, and June 28, 1890.

[5] *Vide* Horace Green, *Pulmonary Consumption*, N. Y., 1864.

a rigid system of inspection should be instituted at slaughter-houses and at the establishments of sausage-makers and the like.

The Mosaic prohibition of pork and the rabbinic ordinances as to the killing and examination of food-animals might profitably be adopted by all civilized states. The method of slaughter drains the animal of blood, and the laws of inspection provide for the rejection of the carcass upon the slightest evidence of pulmonary or pleural disease. Animals dying spontaneously or by injury other than deliberate slaughter for food purposes are likewise rejected.

Meat not inspected should be thoroughly cooked; but as underdone meat is often therapeutically desirable, it is well to advise patients to obtain the certified meat of animals killed according to the Jewish rites (*kashér*).[1] Raw meat, even if *kashér*, should not be eaten unless no other form of food will answer, on account of the possibility, slight it is true, of infection by tænia. The drinking of blood has nothing to recommend it, and should be interdicted.

Sputa.—As the stools of patients with intestinal ulcerations and other purulent discharges are usually properly received and destroyed, the only products from tuberculous persons that are likely to become sources of infection are the sputa of consumptives. It is possibly true, as claimed, that "a patient on the road to recovery may be reinfected through his own sputum;" and at all events over-caution can do no harm. It is not any exhalation from the patient or from the moist sputum that is dangerous, but the dried and pulverized sputum floating in the air as dust. This dust, as shown by Cornet,[2] may lodge upon the hangings, wall-paper, and furniture of rooms occupied by consumptives, and retain for a long time its power of infecting susceptible animals. In view of these researches of Cornet and those of Spillman and Hausshalter[3] as to the transportation of infectious matter by flies from spittoons to articles of food, it is well to adopt the following precautions from among those recommended by various authorities:

Consumptives should not, except when prohibited from lifting the head to expectorate, spit into cloths, handkerchiefs, or towels. Any cloth or handkerchief used for expectoration should be promptly burned. Japanese paper handkerchiefs can be obtained at a very trifling cost, and are far preferable to cloths.

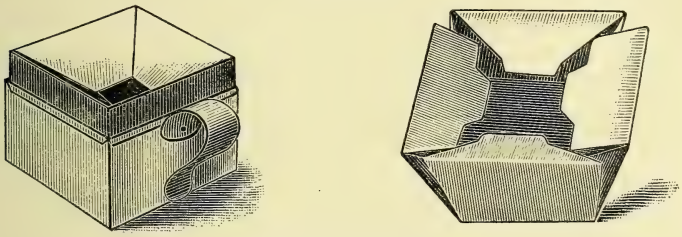
[1] The alleged immunity of Jews from tuberculosis is not borne out by my personal experience; but large statistics seem to demonstrate at least a relatively low mortality among that race; and the greater number of my own tuberculous Jewish patients has been among those disregardful of their religious sanitary laws. Other facts having a possible bearing on the subject are that the rabbinic laws do not provide for the examination of any organ but the lungs, and that no examination at all is required to be made of poultry.

[2] *Zeits. für Hygiene*, Bd. v., 1889, p. 191, *et seq.*; *Berlin. klin. Woch.*, 1889, Nos. 12–15.

[3] Cited in *New York Med. Journ.*, Sept. 17, 1887, p. 327.

In the house a non-metallic cuspidor may be used. It should be kept covered, and contain a sufficient quantity of water to prevent the contained sputum from drying. If preferred, solutions of carbolic acid (5 per cent.), mercuric chloride (1 per cent.), or other reliable disinfectant may be used, but this is not absolutely necessary. To avoid the ugly look of ordinary cuspidors, patients who so desire can readily find in the shops porcelain cuspidors enclosed in metallic frames of ornamental design, with a lid which opens through pressure upon a foot-pedal; lid and pedal forming part of a design; as, for example, the back and tail of a tortoise. Cuspidors should be frequently emptied, and thoroughly cleansed with a disinfecting solution or exposed for some time to the action of boiling water. Care should be taken not to deposit the contents where the sputum, becoming dried, would be a source of danger. Destruction by fire is always the best method, and for this reason the little pasteboard cups supported in a rim of metal (Fig. 146), now to be obtained in America, are to be preferred to the

FIG. 146.



Sanitary Cuspidor.

permanent cuspidor. They should contain sufficient water or disinfecting solution to prevent the sputum from becoming dry, and at the end of the day, or sooner if necessary, should be thrown with their contents into the fire.[1]

Spitting into the public gutters or on the street pavement or country road is not only a filthy habit, but a possible source of danger to others. The use of handkerchiefs is considered to be objectionable, as already stated, on account of the drying and pulverizing of the sputum, which may lodge in the pocket, and also because the handkerchiefs will require special disinfection before being washed with other articles.

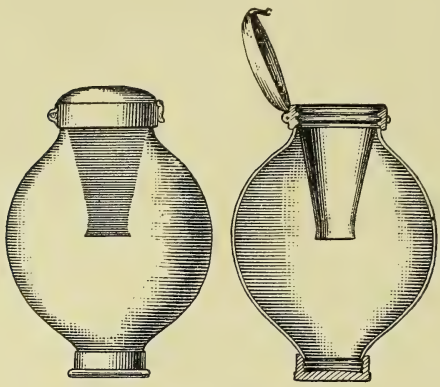
Dettweiler[2] has designed (Fig. 147) a pocket flask that will obvi-

[1] The New York City Health Department advises that "wooden or pasteboard cups with covers should always be at hand for the reception of sputum. These cups are supported in simple racks, and at least once daily, or more frequently if necessary, should be removed from the rack and thrown with their contents into the fire" (*Med. News*, June 8, 1889, p. 636).

[2] *Therap. Monatshefte*, May, 1889.

ate the necessity of expectorating either on the street or into a handkerchief. "It is made of blue glass, is flat, and holds about three fluidounces. There are two openings, one at the top and one at the bottom, both having metallic screw-caps. The upper opening, which is the larger, has in addition a spring cover or lid which closes tightly; also a polished metal funnel which reaches halfway down into the flask. This funnel acts similarly to that of certain ink-bottles, and prevents the spilling of the contents of the flask even if the cap is left open. The lower opening is designed to aid a thorough cleansing of the flask." It should be kept partially filled with water or disinfecting fluid. If used on the street its contents should be promptly emptied into the fire on returning home. If used in the house, it should be emptied at frequent intervals. It should be cleansed with disinfecting solution or running water or boiling water, at least daily, proper disposition being made of the matters removed in cleansing it.

Fig. 147.



Dettweiler's Pocket-flask.

Consumptive patients should be told not to use the public spittoons in libraries,[1] hotels, clubs, bar-rooms, and other public places; and as the prohibition is likely to be disregarded by the majority, the rules already laid down as to the care of these receptacles should be strictly observed.

Flick,[2] from his studies of the houses containing cases of tuberculous disease in the Fifth Ward of the city of Philadelphia, believes that infectious principles may remain in undiminished virulence for years in the plaster, paper, timbers, etc. of rooms formerly occupied by consumptives, and give rise to new cases in those afterward making use of the rooms. I have not been convinced by his statistics; nor does the theory accord with the natural history of the *Bacillus tuberculosis*, even granting to the full its pathogenetic power. At the same time, I cannot oppose the recommendation to remove all possible sources of danger by thorough cleansing and disinfection of the rooms occupied by consumptives in private houses, hotels, and hospitals before permitting them to be occupied by other individuals or by the same individual after recovery. To facilitate this, the furniture and hangings should

[1] Even library books, according to Cornet (*loc. cit.*), may transmit infection.

[2] *Trans. Philada. Co. Med. Society*, vol. x., 1889, p. 197, reprint, Philada., 1889.

be as simple as possible, so that they may be easily subjected to ordinary processes of disinfection. Thorough ventilation at all times of these and all other public and private rooms should of course be enforced.

It has been recommended that articles of furniture and the walls of apartments used by consumptives should be frequently rubbed down with bread which is then burned, or wiped with a cloth dampened with some antiseptic solution; that the floor should be sprinkled before sweeping, and the sweepings burned; that carpets and curtains be shaken in the open air at a distance from houses, and exposed at intervals to the air and sun; that bedding and clothing be disinfected by prolonged boiling.

Whittaker has called attention to possible dangers in railroad travel, and more especially in sleeping-cars. The pathologists of the New York City Health Department[1] say that "steamship companies should be obliged to furnish separate apartments for consumptive persons, so that no person in the exigencies of travel need be forced to share his room with one who might be a source of active danger to him." For other than bacillophobic reasons I concur in this advice, though under ordinary circumstances danger of infection is at a minimum on the sea. The exclusion of consumptives from certain employments, such as those of midwives, nurses,[2] milkmaids, bakers, cooks, waiters, and all having to do with the preparation and handling of food-stuffs, is urged by Heller.[3]

The danger of the transmission of tuberculosis by a consumptive *Mohel* in the performance of ritual circumcision by a method discountenanced among most Jewish communities is actual.[4] If the theory of transmission by sputum be correct, tailors, seamstresses, laundresses, and the like may be centres of infection.

No one should share the bed of a consumptive, nor his room if it can be avoided, for he needs all the air-space an ordinary bed-chamber supplies. Kissing on the lips should be discountenanced when one of the parties is tuberculous. The avoidance of sexual intercourse on the part of the invalid is advisable, not because of possible infection[5] of the partner, but to preserve the patient's energy and to prevent the begetting of tuberculous children.

The hygiene of schools, factories, prisons, barracks, convents, asylums, almshouses, reformatories, and other places where great numbers of

[1] *Loc. cit.*

[2] J. C. Wilson, *Journ. American Med. Ass.*, Mar. 22, 1890, p. 402, reports a case of transmission of tuberculosis to an infant by a phthisical nurse who was in the habit of moistening in her mouth the nipple of the feeding-bottle.

[3] *Wiener med. Woch.*, cited in *Journ. American Medical Association*, Jan. 4, 1890, p. 20.

[4] Meyer, *N. Y. Med. Presse*, June, 1887, has collected many cases.

[5] Fernet, *Rev. des Sci. méd*, July 1, 1885, asserts that infection does occur.

persons are gathered should be scrupulous. If the prevalent bacillophobia should have no other effect than to bring about the long and sorely-needed reform of such institutions, it will have done a lasting good. Cases of phthisis should not be treated in the common wards of a general hospital.

To complete this subject we must again allude to the fact that wounds and catarrhal inflammations may afford entrance for the tuberculous virus and cite the warning of Degive[1] and others against transmission of tuberculosis in vaccine virus derived from an infected child or an infected calf.

While I thus reproduce and endorse much of the current teaching of the contagionist school as to public and private precautions against the spread of tuberculosis by infection, I would urge the utmost tenderness and consideration in the manner of carrying out this advice. The consumptive needs encouragement; it is an essential factor in treatment. To make him feel like a walking pestilence, to shun him, to shut him out from human companionship, to render him an object of horror to himself and of avoidance to his kind when "sitting in the house or walking by the way, lying down, or rising up," is as unnecessary as it would be brutal.

One other point remains to be mentioned in this place, so that its position may make it emphatic.

Not tuberculosis directly, but hypotrophy leading to subsequent tuberculosis, is often acquired by those who in close and loving attention to the sick, forget the necessary care of self. Many of the cases of apparent transmission of disease from husband to wife may be thus explained—an explanation rendered more probable by the comparative rarity of instances of apparent transmission from wife to husband; for the husband is usually compelled to attend to his daily occupations, and this keeps him out of doors. It is the duty of the physician to see that the devoted wife, sister, or mother is not confined too closely to the sick-room, and that she obtains the needed rest, food, and air.

We may now turn our attention to the most important division of prophylactic and of curative measures.

Reinforcement of Vital Energy.—Earth, Air, Fire, and Water were the four kingdoms of ancient philosophy. Not very different are the provinces of the kingdom of prophylaxis, which we are now about to survey.

Having to regulate the life of a person in whom we have reason to fear the development of tuberculosis,[2] we must consider—

[1] *C. R. Cong. pour l'Étude de la Tuberculose*, f. i. p. 157.

[2] The same general principles apply of course to those not of tuberculous inheritance, who should be prevented from acquiring the hypotrophic constitution. "It is

1st, his place of *residence*, in relation to (*a*) the climate, (*b*) the soil, (*c*) the air (including moisture and heat) and light within and without the dwelling, and especially as concerns his own apartments.

2d, his *clothing*, with respect to (*a*) material, (*b*) fashion, (*c*) quantity, (*d*) suitability to climate, season, and weather.

3d, *diet*, prescribing (*a*) quality, (*b*) quantity, (*c*) frequency of meals, and (*d*) manner of eating.

4th, the use of *water* hygienically and therapeutically.

5th, *rest* and *exercise*, including (*a*) occupations and (*b*) amusements, physical and mental, usual and occasional, (*c*) sleep, and (*d*) division of time.

6th, the use of *air* at modified *pressures*.

7th, the use of *medicines*, so far as this may be properly termed prophylactic.

In attempting to regulate the daily life of a person not actually "sick" we shall encounter many difficulties. On the one hand, the largest number is not able to follow our advice in its entirety, more especially that which relates to residence, occupation, and division of time. On the other hand, those who are able to follow advice in all respects are not always to be convinced of the necessity for so doing, or they become careless after a time, the more so if health has been conserved. It is impossible here to consider all qualifying circumstances. We shall endeavor to map out a general plan capable of modification, but stating clearly what measures are most desirable, and should therefore be carried out if possible.

Prevention, though difficult, is so much easier and so much more important than cure, and the principles of cure are so nearly identical with those of prevention, that we cannot spend our time in a more profitable study than that of prophylactic hygiene, or, as it may with propriety be termed, the therapeusis of hypotrophy.

The Therapeusis of Hypotrophy.—We have seen that the prevention of hypotrophy should begin before conception. Its treatment must often begin with birth.[1] It will facilitate our study to consider congenital hypotrophy only, for the principles of the management of the acquired condition are the same, the details being perhaps less rigorous. We shall first discuss in a general way the measures to be adopted in infancy, and thus become prepared to take up in a more detailed and systematic manner, in relation with other periods of life, the special features already enumerated.

I recognize, in common with the older writers, a condition of innate

important," said Graves, "to know how to make a man phthisical, as by pursuing an opposite line of conduct we will be able to prevent it."

[1] "To those who will listen to counsel I would recommend it to begin their measures for preventing consumption from the very cradle" (Beddoes, *loc. cit.*).

liability to tuberculosis, already sufficiently dilated upon, which I shall hereafter term the tuberculous or strumous diathesis. It includes, but is not limited to, scrofulosis.

I believe that under this latter term, as under the term "tuberculosis," different abnormal conditions—all hypotrophic, however—are included; but I confess my inability from study or observation to discriminate accurately among them. The scrofulosis resulting from syphilis is probably different from that which results from tuberculosis, yet it may, as Lugol has shown, eventuate in tuberculosis. The therapy in the present state of knowledge can be differentiated empirically only. To this subject we will recur in connection with medication. The hygiene is identical.

Children exhibiting signs of the strumous diathesis, or those in whom there is reason to suspect its existence, even in the absence of positive signs, should be treated, if possible, from birth. Their nourishment must be unexceptionable. The warning against permitting suckling by a strumous or debilitated mother for the mother's sake may here be again repeated for the infant's sake. "Without supposing that the seeds of disease could be conveyed by suckling," says Beddoes, "I should prefer the milk even of a healthy cow—if a wet-nurse could not be procured to my satisfaction—to that of a gland which probably partakes of the constitutional feebleness."

Artificial feeding should not be resorted to, but a young and vigorous wet-nurse be obtained. Not once, but many times, have I seen an infant of the class under discussion fail to thrive upon its mother's milk and do badly upon the most approved artificial food, but apparently drink in a new life from the breasts of a foster-mother. In France, when a wet-nurse cannot be obtained, the child is often permitted to suckle a goat. Goat's milk and ass's milk, as before stated, are preferred by French authors to cow's milk. Jaccoud advises that weaning should be postponed to as late a period as possible, eighteen to twenty-two months; Meigs and Pepper say the same; but Jacobi does not endorse this advice. We must, in this as in other matters, be guided by circumstances, especially by the manner in which the child appears to thrive. The longer it can suckle and do well, the better. Weaning, in any event, should be quite gradual. It should not be undertaken during the summer months, but the child should be nursed, if possible, through that dangerous period. When artificial food becomes necessary, the greatest care should be observed in its selection and preparation, and in the care of bottles, nipples, glasses, etc.

When a child does not flourish despite the supply of the best human milk, inunctions of cod-liver oil, olive oil, or cocoanut oil are often of service. The oil should be warmed and applied over the abdomen especially. In some cases a little alcohol helps matters. A good way

is to give from five to twenty drops of brandy or port wine in a little water just before or after nursing two, three, or more times in the day. A minute dose of tincture of nux vomica, suited to the age of the child, may be given in simple elixir, the effect being closely watched. Cinchona preparations and syrup of the iodide of iron, or arsenic, preferably as Donovan's solution, may have to be added to the treatment. The subject of supplementary foods must also be considered. A suitable preparation of cod-liver oil may be administered. Emulsions containing pancreatin are the best. An extemporaneous emulsion containing from 10 to 25 per cent. of cod-liver oil, with one-half to one-quarter grain of Fairchild's extractum pancreatis, or Parke, Davis & Co.'s pancreatin, and about five drops of compound spirits of ether to the dose, may be given in tea-spoonful or dessert-spoonful doses to an infant of six months. Preparations of malt sometimes serve a good purpose. A few grains of Horlick's malt, placed dry on the tongue from time to time, will be taken with relish and often greatly improve nutrition. A child one year old can take half a tea-spoonful two or three times a day. Whether the child be suckled or artificially fed, it is sometimes well, if digestion seems feeble, to administer two or three times a day a small quantity of some preparation of predigested meat, dissolved in milk or water. Beef-juice and the preparations of blood to be found in the shops may be given, but in most cases are less useful. Peptonized beef-tea may be prepared at home, and given in sufficiently weak dilution with a little alcohol. I speak of quantities and strength in this vague way, because exact figures cannot be given. It is a question of good judgment in the individual case.

Attention should be paid to the evacuations. The bowels should be kept moderately active. If sluggish, an occasional enema of warm soapsuds, with a little table-salt and oil of turpentine added, should be given to wash out the tract (one drachm of salt and half a drachm or less of oil of turpentine to the pint of water). If the discharges are fœtid or unhealthy-looking, a little calomel is usually the best corrective. According to the age of the child, from one-thirtieth of a grain to one-twelfth of a grain of calomel may be given, rubbed up with a grain of sugar of milk, with or without the addition of sodium bicarbonate. Pepsin (one-half to one grain) and a fractional dose of Dover's powder (one-tenth grain or more) may be added, as in ordinary cases of gastro-intestinal catarrh, if indicated by indigestion or diarrhœa. Pancreatin has been given, but it is not always satisfactory. Mercury with chalk is sometimes better than calomel. The habitual use of any mercurial, however, is to be deprecated. Peppermint, aromatic syrup of rhubarb, powder of rhubarb, castor oil, olive oil, salol, bismuth salicylate, in appropriate doses, are among other suitable medicaments. But when seriously disordered digestion or symptoms of grave disease

are present, these must be treated according to the special indications elsewhere discussed.

A sufficient quantity of water should be given to keep the kidneys fairly active and to supply the various needs of the economy for that nutritive fluid.

In American cities it is a wise precaution to boil all water used for drinking purposes by infants or adults, hypotrophic or orthotrophic.

The best possible general hygiene ought to be conserved.

The child should have a sufficiency of sleep. It should not sleep in the same room with the affected parent. It should be bathed at least once a day, preferably twice a day, night and morning, and the water should be by degrees brought to as cool a temperature as can well be borne. While tepid water is to be used at first, and continued, if in winter, until the weather becomes sufficiently mild, daily bathing or sponging with cold water should be instituted as soon as possible; and the habit formed in infancy may advantageously be continued throughout life. In cases of premature birth, however, as external heat is so important a feature in the treatment, the adoption of cool bathing will be long postponed.

Sometimes the child may stand in warm water while being sponged with cold water. The addition of salt,[1] of alcohol, of vinegar, of ammonia-water, and of aromatics to the water of the bath is often advised, and seems beneficial. The bath should not be prolonged, and should be followed by brisk but gentle friction with a Turkish towel. Massage, preferably friction, percussion, and kneading, may often be superadded with decided benefit. The result of these measures should be seen and felt in the glowing warmth of the skin and the vivacity of the little one. In some cases a healthful tendency to sleep is one of the effects. If, however, the child fails to react well from a cold bath, tepid bathing must be resumed and practised until it becomes stronger; the change in any case being gradual. When at the seashore the bath may be of sea-water, warmed if necessary. Older children (three years of age or more) should be encouraged to go into the surf.

The clothing should be warm, but light and porous. Too many garments or garments of too great weight should be avoided. The limbs should be free, and there should be no constricting band about the chest or waist. If the child is very much pot-bellied a bandage may be kept about the abdomen, but in the absence of special indication the bandage is better omitted. Silk, woollen, or some scientific mixture of wool and

[1] Gillett (cited in *Archives of Pædiatrics*, p. 141, 1890) uses sea-salt, 100 grammes; ammonium chloride, 25 grammes; essence of thyme, 5 drops; water, 20–25 litres. I am in the habit of using salt or ammonia-water and alcohol by rule of thumb—about a tea-cupful of salt if the child's bath-tub be half filled, and about the same quantity of alcohol to a quart or two of water.

cotton, such as that known as "Jaros sanitary wear," is a preferable material for under-garments. Stockings should be of silk or loosely-knitted wool. If there is much tendency to nasal or bronchial catarrh or to otitis or otalgia, a loose silk or woollen cap may be worn, unless it induces objectionable perspiration or otherwise seems injurious. Caps should not be used without special indication, and may be dispensed with when the hair has grown to sufficient extent to be a protection. Catarrhal inflammations should be promptly treated, as they may afford a lodging-place for infectious matters. "A healthy mucous membrane is the best preventive" (*Jacobi*).

I find it a good prophylactic plan to wash the mouth and back of the throat (as far as the finger carrying a moistened linen cloth can reach) night and morning with a solution of boric acid. When necessary the nose is cleansed by gentle instillation of boric-acid solution (tepid). If done gently, the child, as a rule, soon becomes accustomed to it, and there is no trouble. Glandular enlargements should be promptly treated, as set forth in the article on Scrofulosis.

The child should be in the open air and in the sunshine as much as possible. The country is better than the city, and, unless there is an active inflammatory disease of the respiratory tract, the seashore is better than the inland country. On favorable days the child may sleep out of doors. On the other hand, exposure to bleak winds or to a moist or foggy atmosphere is to be scrupulously avoided.

In individual cases general statements do not always apply. With this qualification, we may confidently assert that dry, cold air is never harmful, but is, in the vast majority of cases, beneficial. It is "tonic" and "bracing." Damp and warm air, even at the seashore, is injurious. It favors catarrhal and other pathologic processes; favors the growth and reproduction of most microbes; favors the dissolutional processes in organic tissues dying or dead; and produces a "soggy" condition of the respiratory mucous membrane that tends to impede circulation and otherwise depress vitality. There are other atmospheric and telluric conditions, not thoroughly understood, usually associated with heat and moisture, that seem to add to the general ill-effect.

The living- and sleeping-rooms should be well ventilated throughout the entire twenty-four hours, but draughts are to be avoided day or night. Screens may be used to protect the crib.

The temperature of the room should not be allowed to get too low, or, when this latter can be prevented, too high. From 65° to 70° F. is a fair, average temperature. When possible and no counter-indication exists, the lower limit should be aimed at. The higher limit should not be (voluntarily) exceeded except as a special therapeutic measure in the treatment of bronchitis or other condition necessitating

it. Too great warmth in the house is the cause of many a "cold" taken by children.

Furnace heat should not be used. Steam-heated radiators are not objectionable, provided due provision for moisture be made. If there is not an open fireplace, a small wood-stove may be readily managed in the nursery. Even the open fireplace has its drawbacks, and the subject must be carefully studied with reference to individual conditions and possibilities.

Sudden or frequent changes of temperature, especially from heat to cold, should be avoided. Care in this respect is specially necessary at night.

Weaning and dentition require more than ordinary care, but the principles of their management do not differ from the usual good rules of cleanliness, fresh air, relief from local irritation, proper selection of food, and scrupulous care of feeding-vessels.

Small quantities of meat-juice, bouillon, soups, or peptones should be given as soon as weaning has been fairly accomplished, if they have not earlier been rendered necessary. A little scraped meat, not raw, however, and finally a portion of rare broiled chop or steak, may in the course of time be added. Sterilized milk, to which salt and lime-water have been added, must form the staple article of diet. If not well digested it may be peptonized, or some of the foods composed of "sterilized, desiccated milk solids, partly predigested," with the addition of malt, gluten, etc., may be temporarily resorted to or a digestive ferment be prescribed. Digested foods and digestive ferments should be gradually withdrawn as the necessity for their use becomes less. While they can be persisted in without danger for prolonged periods, it is much better to reserve them for special occasions and to educate through exercise the innate digestive powers.

Barley-water, rice, eggs, very small quantities of farinaceous food, or none at all, cream, butter, small quantities of stale or toasted bread or soda biscuit, junket, whey and wine-whey, are among the foods that may from time to time be added to the list in accordance with age and digestive powers. If indicated by the sluggishness of dentition or the condition of the teeth or of the bones, a little calcium lacto-phosphate may be given. This may be obtained in mass, and a small fragment, about the size of a silver three-cent piece, be placed on the tongue once or twice daily. The child will take it with relish and ask for more.

As the child advances in years the same strict supervision over daily life should be maintained, while the details will vary with varying circumstances. When the inheritance of the tuberculous diathesis is only collateral and the individual seems vigorous, the institution or maintenance of the preventive discipline is not so necessary as when the disease exists in the direct line of descent. If, however, other

children of the same parents, or even other grandchildren of the same grandparents not deriving their tendencies from the other line, have suffered, the same care must be taken in cases of collateral inheritance as in cases of direct inheritance. Certain stages of development seem more trying than others to the organism. The approach of puberty is specially a period of great solicitude, as the organism is now to be put to a severe strain. Puberty having been safely passed, new dangers arise, more particularly in males, and the years between eighteen and thirty are peculiarly fraught with anxiety. While no period of life is free from danger, yet that between thirty-five and fifty is the most favorable. At fifty, decline often begins and renewed care is necessary. We shall consider in general terms the rules of life applicable to all ages, except where special comment as to age is needed. Again, we are compelled to recognize that in too few cases can our advice be completely carried out, and that it must be modified in accordance with pecuniary and other exigencies. In the cases where it is most needed, unfortunately, it is least possible of fulfilment. In such cases it becomes all the more necessary to insist upon those points which are possible. Even in the city open air is preferable to that of the house, the street preferable to the alley, the square preferable to the gutter. The busiest mother can and must find time to bathe her infant. Older children can be taught to bathe themselves. Good milk costs no more than the chalk and water of the dishonest dealer, and boiling it requires very little time. The most contracted quarters can be kept clean. The physician is in duty bound to advise the poor as well as the rich concerning those matters outside of drug-taking which are so much more vital than the prescriptions with the writing of which too many of us content ourselves.

Seaside sanatoria, "country-week associations," and other benevolent societies in all the cities of America are multiplying the opportunities afforded to the children of the poor. Civic authorities are beginning to realize the necessity for measures of public sanitation that shall remove the dangers that now flourish in crowded tenements and noisome lanes.

Just here still another consideration must detain us for a moment. The physician who has wealthy patients should interest them, if only from a selfish standpoint, in the public improvements and private assistance that are needed to bring health to the poor. Pestilence born in the hovel soon seizes upon the mansion. If there be infection in tuberculosis, that infection is cultivated and perpetuated in the unwholesome rookeries that the poor are forced to call their "homes." But it does not remain confined to its breeding-places: it spreads broadcast to avenge the miseries of Lazarus upon the children of Dives.

To return to our main theme. Country residence, open-air life, exposure to the sun, appropriate clothing, daily bathing, judicious alternation of rest and exercise, proper food, regular habits,—lose none of their importance as development progresses.

Residence.—Jaccoud[1] says: "A person in whom, for any reason whatever, the development of tubercle is considered probable should live in the country so long as any suspicious constitutional debility remains, and until the age that is specially to be feared has been passed without disease. Such a residence should be permanently occupied both in winter and summer, the air in town being less favorable than that of the country, even in cold seasons; and the dangers of a chill, when once the method of confinement is abandoned, are not greater in the country than in town. A country life furnishes the only means of fulfilling a fundamental part of the prophylactic treatment, ... that of living in air that is pure and constantly renewed."

The importance of due renewal of the air cannot be over-estimated. Stagnant air, like stagnant water, is unfit to sustain vertebrate life.

B. W. Richardson's researches on "vitalizing and devitalizing oxygens"[2] have conclusively demonstrated this fact. He showed that even when carbon dioxide and all other known products of respiration had been removed from oxygen that had been breathed and rebreathed by the animals he experimented upon, so that it sustained the combustion of a candle, and to all chemical tests appeared to be pure, warm-blooded animals nevertheless passed into a state of narcotism, and finally of death.

That this was not due to a volatile metabolin contained in the expiratory current, as has been suggested by Brown-Séquard[3] and D'Arsonval, is proved by the facts that the untoward effect could be entirely prevented, or the animal, if not too far gone, be revived, not only by the readmission of fresh oxygen, but also by electrifying the rebreathed oxygen. Richardson thus seems entirely justified in concluding that "during the contact of the oxygen with the blood or the tissues of the animal some quality essential to its vitalizing power is lost."

Whatever theory be adopted to explain the results obtained by the great observers cited, whether we agree with that of the Englishman or that of the Frenchman, the practical lesson is the same. The hypotrophic subject must avoid crowded rooms, live as much as possible out of doors, and reside where the atmosphere is "vitalizing." If unable to reside continuously in the country, he should make the effort to get away from town, if only for a brief period, at stated intervals during all seasons of the year.

A few words are necessary as to the choice of locality for permanent

[1] *Op. cit.*, p. 95. [2] *The Asclepiad*, 1887, No. 14, vol. iv. p. 172, *seq.*
[3] *Le Bull. Méd.*, 1887, p. 1263 et p. 1299.

residence or occasional resort. As the whole subject of climate is treated at length in a special paper contributed to this SYSTEM, we may here be general and brief. While the question is of weight with relation to all forms of tuberculous disease, its greatest importance is in relation with phthisis pulmonalis. Recognizing that climatic measures are among the most difficult to carry out, whether in prophylaxis or in cure, we will first consider what is most desirable, afterward giving due prominence to the best substitutes.

Many of the requirements of a desirable climate for the consumptive and for the person whom we desire to protect against consumption are the same; but certain special features are more advantageous in prophylaxis, others more appropriate later. Then, too, differentiation must be made as to the form and stage of threatened or existing disease; while individualization is always necessary. There can no more be one climate for all than one coat for all.

We discriminate, first, as to the aim of climatic treatment: prevention or cure. Both in prevention and in cure we discriminate further between "protection" and "invigoration." We have therefore to consider whether we simply wish our patient to avoid dangers which might attend his residence in certain localities, while trusting for positive effect in improving his condition to general measures of hygiene and therapeusis; or whether we desire by some particular quality in the chosen climate to bring about certain definite effects that cannot be achieved elsewhere.

An intermediate position can also be assigned to certain localities—those, namely, which by reason of their general equability permit the open-air life to be carried out more perfectly in the case of certain subjects.

The ideal climate for the consumptive to survive in or the hypotrophic subject to be guarded from exposure—a climate which exists, so far as I know, only as an ideal—is characterized first by relative equability; but it is not absolutely unchanging, for this would produce a physical as well as a mental *ennui*. There is always sunshine, the air is dry though not parched,[1] the temperature moderate. Warm climates are for those only who need continual protection: they exert no positive curative influence; cold is usually beneficial in treatment, and in prophylaxis, more especially when conjoined with altitude. There is sufficient rainfall, but the soil soon becomes dry again, so that one may walk out in a short time after the rain ceases. Springs or brooks, whose purity is guarded, supply clear, refreshing water. There are mild breezes to keep the air in motion, but no bleak winds.

[1] Denison, "The Preferable Climate for Consumptives," *Trans. IX. Internat. Med. Cong.*, vol. v., reprint Denver, 1890 (p. 11), forcibly argues that dryness and equability are incompatible. He assigns greater merit to the former.

The ideal climate for one to get well in, is less equable, more bracing; while in the best form of prophylaxis—that which aims not so much to guard against assault as so to strengthen the organism that assault may be successfully resisted—changes are useful, provided they are not sudden or extensive. They materially assist in developing the health-preserving powers of reaction.

For all, the ideal air is pure, coming from regions beyond human contamination, constantly renewing its supply of "vitalizing oxygen," and going to be depurated before it has imbibed sufficient noxious matters to become injurious. It is also restorative by reason of its ozone and its balsamic, terebinthinate, or mineral vapors, which exist, however, in small proportions,[1] so that one soon becomes unconscious of them save when they are recalled to attention by contrast. Nevertheless, there is always experienced a sense of delight in respiration, apart from the gratification due to odor. There are charms in the scenery to take one out of doors and make it pleasant to remain out. If specially delightful spots are within reasonable distance of one's house, so that an incentive is given for little jaunts, it is so much the better. Human habitations are not closely packed, but scattered about, so that each and all have free air-space.

The nearest approaches to the ideal are found among the pines in mountain-regions, at the seashore, and on the sea[2] at certain times of the year, varying with the region. These are alike in their openness to the sun and in the constant circulation of air. On the other hand, Glover[3] points out that "sheltered valleys, where the sun's rays rarely penetrate and air is excluded, are hotbeds of scrofula."

While between one seaside station and another, and between one mountain station and another, great differences may exist; and while no one feature of the composite that makes up the climate of a particular region should be unduly emphasized; we must here note that between mountains in general and sea in general there is a great difference in atmospheric pressure. It depends upon the individual, and, if there be existing pulmonary disease, upon the progress of the lesions and upon associated symptoms, whether the rarefied atmosphere of altitude will or will not be beneficial. Full discussion of this phase of the subject will be more appropriate elsewhere. In a general way, it may now be stated that rarefaction is advantageous when it is especially desired to increase pulmonary capacity and strengthen by exercise the respiratory muscles; provided

[1] There is such a thing as air being "too stimulating," and the researches of Richardson in England and Draper in America have established a relationship between "ozone" periods of the atmosphere and the occurrence of pneumonia. Richardson has also experimentally shown the power of ozone to produce inflammation of the respiratory tract. (See *Asclepiad*, 1885, p. 384.)

[2] Consult Wilson, *The Ocean as a Health-resort*, London, 1881. [3] *Op. cit.*

there is no counter-indication in the state of the heart or vessels, or in the neurotic temperament of the patient. Residence in high regions at low atmospheric pressure stimulates also peripheral circulation, and thus by combination of respiratory and circulatory effects improves nutrition. Progressive emaciation, with hectic, is, however, a counter-indication to altitude. The degree of elevation most desirable or permissible varies with the individual case, and difference must be made between continuing to reside at a high station and going there at a certain time of year or in certain stages of disease. When the prime object is not to influence respiration or circulation especially, but to stimulate cellular nutrition either directly or through a gentle effect upon nervous function—or, on the other hand, if the aim is to check waste apparently due to an over-excitation of nervous function—the sea-air is often more efficacious than that of the mountains, and a sea-voyage is preferable to a sojourn at the seaside. Active inflammatory processes, catarrhal or other, in the respiratory tract, laryngeal ulceration, and active pulmonary softening, even without marked febrile phenomena, are, as a rule, counter-indications to life at the seaside, though not to a sea-voyage; and possibly not to the atmosphere of a small island continually swept by breezes from the open sea. Rush[1] remarks that "it is a singular fact that while consumptive persons are benefited by the sea-air when they breathe it on the ocean, they are always injured by that portion of it which they breathe on the seashore." He quotes Irvine to the effect "that those situations which are in the neighborhood of bays or rivers, where the salt and fresh waters mix their streams together, are even more unfavorable than the seashore to consumptive patients, and therefore should be more carefully avoided by them in exchanging city for country air." Tyndale[2] quotes H. I. Bowditch, "that the sea-coast of New England, and possibly of the Atlantic still farther south, *is always injurious to the consumptive at any period of the disease.*" Many persons, too, children as well as adults, have an inexplicable idiosyncrasy against the seaside, and on the contrary do well in the mountains. Jaccoud advises for prophylaxis, or in the treatment of incipient pulmonary phthisis, either mountain-life or a sea-voyage. In regard to the latter he points out that it must be sufficiently long, as a week must commonly be allowed to recover from sea-sickness and its effects.

Tyndale[3] prefers to use in comparison the terms "sedative" and "stimulating" climates rather than the "vague designation" of sea and mountain air. "Sedative means: Equability of temperature with very considerable or with only moderate moisture, and in temperature

[1] *Medical Inquiries and Observations*, 2d ed., Philada, 1805, vol. ii. p. 113.

[2] "On the Relative Importance of Elevation, etc., in the Climatic Treatment, etc.," *Archives of Medicine*, vol. x., Nos. 2 and 3, 1883, reprint N. Y., 1883. [3] *Loc. cit.*

hot, warm, or cool. Stimulating means: Very great or moderate dryness, with low, medium, or high altitude, and in temperature cool or cold, according to latitude." The latter he prefers for prophylaxis and for cure. It is counter-indicated by excessive nervous irritability. When there is decided irritation of mucous membrane and skin, or a tendency to inflammatory processes, or when there is or has recently been active inflammation, he prefers the sedative climate. He looks upon it, however, "only as an expedient; a palliative that is to serve as a stepping-stone to medium and high altitudes, in order that the well-known effects upon the thorax and circulation may be ensured, after decided irritation or tendency to inflammation of mucous membranes has been in a measure reduced."

Before leaving this subject we must quote the latest conclusions of C. J. B. Williams and C. Theodore Williams,[1] as any article, however brief its scope, that failed to give due weight to the results of the prolonged observation and careful study of these observers would be incomplete. High-altitude stations, they state, are most beneficial for cases of—"(1) marked hereditary predisposition in which phthisis is either threatened or in a state of early development; (2) imperfect thoracic or pulmonary development; (3) hæmorrhagic phthisis; (4) chronic pneumonia (without bronchiectasis), which does not resolve; (5) chronic pleurisy, where the lung does not expand after removal or absorption of the fluid; (6) phthisis accompanied by more or less pneumonic consolidation; (7) chronic tubercular phthisis in its various stages, provided the lung-surface be not too largely involved to admit of proper respiratory change at the high altitude, and there be no pyrexia."

Mountain climates are counter-indicated in cases of—"(1) emphysema and phthisis with emphysema; (2) chronic bronchitis and bronchiectasis; (3) diseases of the heart and great vessels; (4) affections of the brain and spinal cord and states of hypersensibility of the nervous system; (5) diseases of the kidney and of the liver; (6) diabetes; (7) catarrhal phthisis; (8) phthisis with double cavities, with or without pyrexia; (9) all cases of phthisis in which the pulmonary area is too largely encroached upon to admit of the proper performance of the respiratory function; (10) cavity cases with profuse hæmoptysis, pointing to the probable existence of a pulmonary aneurism; (11) cases of phthisis with great irritability of the nervous system; and (12) patients advanced in years or too feeble to take exercise."

The cases best suited for sea-voyages[2] are—"(1) hæmorrhagic phthisis; (2) scrofulous phthisis, especially where fistula has developed; (3) cases of limited consolidation or cavity, where without pyrexia the cough is hard and obstinate, probably from bronchial involvement; (4)

[1] *Pulmonary Consumption*, 2d ed., London, 1887, p. 373. [2] *Op. cit.*, p. 383.

cases of phthisis with emphysema; and (5) cases of limited tuberculous disease in patients who have been overworked in mind and body."

Climatic change, according to the same observers, is without influence "in cases of acute tuberculosis, tuberculo-pneumonic phthisis, laryngeal phthisis, acute phthisis, except in a few of those instances where the intensity of the tuberculous process has been reduced by extensive exudation and has passed into quiescence. . . . . All cases accompanied by continuous pyrexia or in which the processes of tuberculization or excavation are actively proceeding, advanced phthisis accompanied by intestinal ulceration and diarrhœa." With this I do not altogether agree. I have known a sea-voyage to reduce the pyrexia and limit the morbid processes in active phthisis; and mountain-life to assist in the cure of laryngeal ulceration.

Concerning the temperature, equability when protection is the chief aim, and, in any event, absence of extreme changes and of extreme heat or extreme cold, are more important than the actual thermometric figures. B. W. Richardson[1] prefers a mean temperature of 60° F., with a range of not more than ten or fifteen degrees on either side. While it is true that many consumptives do well, all winter, in cold climates, my own observation has impressed me with the idea that when there is advanced disease a moderately warm, or even subtropical, climate—if not too moist—is usually the best. Many of the reports from cold elevated regions, however, show that certain cases of advanced disease do well in such places; while there can hardly be any doubt that for prophylaxis, and very frequently when there is incipient disease, the colder the climate that can be well borne the better. If one goes to a cold region in summer or early autumn, he can remain there during the winter more readily than if he first goes there in the coldest season. Cold is less likely to be trying to the organism at an altitude than at sea-level, and, when conjoined with comparative dryness of the atmosphere, than with moisture. East winds, as Richardson has pointed out for England, and as the experience of New England physicians confirms for America, have a peculiarly injurious character, which is independent both of temperature and of humidity. Hence residence in winter at exposed points near the sea and at sea-level, such as Boston and New York,[2] is undesirable; while residence at certain points on the New Jersey coast is often bene-

[1] *On the Hygienic Treatment of Pulmonary Consumption*, 1856, reprinted in *The Asclepiad*, vol. ii., 1885, p. 97, *seq.*

[2] "In Salem, in the State of Massachusetts, which is situated near the sea, and exposed, during many months in the year, to a moist east wind, there died in the year 1799, 160 persons; 53 died of the consumption, making in all nearly one-third of all the inhabitants of the town. Consumptions are more frequent in Boston, Rhode Island, and New York, from their damp winds and vicinity to the seashore, than they are in Philadelphia" (Rush, *op. cit.*, p. 114).

ficial. On the whole, however, winter residence somewhat inland among the pines, as at Lakewood, N. J., is to be preferred even to Atlantic City, which is the best of the winter seaside resorts on the middle Atlantic coast of the United States. Here, too, idiosyncrasies—that is to say, individual conditions not yet accurately recognized and defined—play a great part. The weaker and smaller the heart the more difficult is it to bear a cold climate. As in the case of baths, there may be a gradual habituation and education. When the tolerance of cold has been well established it is an evidence of great improvement, if not of recovery.

Change of residence with the season, while quite pleasant and often beneficial to those in health or under prophylactic régime only, is quite as frequently distressing and disastrous to the sick. All things considered, the less change the better, while change in search of greater warmth in winter is highly undesirable. It is not a paradox to say that change for coolness in summer is different from change for warmth in winter, for the question of the object of change has reference to the conditions obtaining at that place which is the residence during the greater portion of the year.

Permanent residence in the location that has been decided upon as the fittest from all standpoints, with occasional trips to places carefully selected for relaxation and change of surrounding, is the best plan to adopt for all the classes of cases we have been considering.

Two factors not yet explicitly set forth are of great importance in determining the question of places of residence or of temporary sojourn: first, the facilities for obtaining proper food; second, the general sanitary conditions. Many otherwise excellent resorts are inadmissible, either because of deficient food-supply or because of impure water, bad drainage, and an unsatisfactory state of public and private hygiene generally.

When choice of residence is impossible—as it is, unfortunately, for most persons—there are artificial means by which we may more or less imperfectly imitate at home certain desirable qualities of the atmosphere of various places. I have elsewhere[1] called attention to some of these, and they will be considered in connection with the subject of pneumotherapy in the further course of this article.

Wherever a consumptive or a hypotrophic person may live, he must live out of doors. If he remain indoors, he will not live long. Air is a necessary food, and it cannot be found in due quantity and of proper quality enclosed within any four walls. Light is probably the ultimate mechanical source of most terrestrial energy. At all events, it is necessary to the due conservation of bionergy. Artificial light will not answer; it must be that furnished by the sun.

[1] "Artificial Climatic Effects for Stay-at-Homes," *Philada. Med. Times*, Feb. 6, 1886.

Even when a patient has advanced disease, he should not stay indoors unless compelled to. It will do no harm to repeat at every opportunity, regardless of the rules of systematic writing, that even the weather should not be allowed, without special reason, to confine one to the house. On cold days, however, some caution may be used in making the change from house to street or road. "When the temperature indoors is much higher than it is out of doors, one should not go into the open air directly from a warm room, or go at once into a very warm room, and still less close to the fire, on coming into the house from without. A few minutes should be passed in the entry in either instance, to render the change more gradual."[1]

But while our ward or patient is to be kept in the open air and in the sunlight as much as possible, yet even in the most favorable locality and in the best of weather he has to spend many of the twenty-four hours in the house. In any climate, therefore, much depends upon the construction of the house, the methods of heating and ventilating employed, etc. These matters are discussed more fully in the special article on Sanitation.

A few words must be said here, however, even at the risk of repetition, as to the preferable sites for dwellings and as to the public regulations that physicians should endeavor to have enacted and enforced, more especially in towns. The higher and drier the site of a house the better it is, city or country. The more open space there is around the house, the better can it be ventilated and the more will it be exposed to the beneficent influences of sunlight. Some of the surrounding ground should, however, be given to trees and shrubbery, in order to obtain the action of the foliage in renewing the supply of "vitalizing oxygen." Dense woods are not desirable, and pines or other coniferæ are to be preferred to deciduous trees. They should not surround the house, and those nearer to it should be very few in number. The north and east sides of the dwelling are the best sites to plant trees, as there they help to protect from wind and do not exclude sun. Grass and flower-beds, in natural state or trimmed and arranged by art, are also helpful as well as pleasing. Rank and overgrown vegetation is neither the one nor the other.

In one of the best of recent papers, Thorne Thorne[2] recalls attention to the necessity of a dry subsoil, as long ago pointed out by H. I. Bowditch[3] in America and Buchanan in England, and to the evidence of the influence of subsoil moisture afforded in the diminution of the mor-

[1] J. Solis-Cohen, *The Throat and the Voice*, Philada., 1879, p. 22.

[2] "The Dwelling-house in Relation to Tuberculous Consumption," *Practitioner*, Feb., 1891, p. 145, *et seq.*

[3] *Med. Communications, Mass. Med. Soc.*, vol. x., 1862; *Consumption in New England and Elsewhere; or, Soil Moisture one of its Chief Causes*, Boston, 1868.

tality from phthisis brought about in Leicester by improved drainage. Quite as significant was the quick neutralization of a similar improvement in Chelmsford by the use of flood-gates at a mill half a mile below the town, thus artificially keeping up the subsoil water. "Few soils are more dangerous as building sites than gravel, unless so circumstanced that it can be kept both dry and clean. . . . . One elementary but very important point in the direction of securing dryness of the dwelling is the need for a 'damp course.' Builders, while ready at times to insert this in the walls at a height of several inches above the ground, fail to take a similar precaution against dampness affecting the walls of cellars and other below-ground constructions. The precaution here needed is the provision of a double wall, the cavity of which is filled with asphalt, and having two damp-courses—one at the foot of the wall, and the other above the level of the ground surface."

"The area of surface enclosed by the external walls of a house needs also to be dealt with. It may be stated generally that so long as water stands within some four feet of the line of the basement floor the site ought not to be regarded as a healthy one. The 'ebb and flow' of such water may be more mischievious than its mere presence. With a rise, large bodies of 'ground air' are forced upward, and this unwholesome tendency is increased in towns where pavements are extending, so that the only outlets are the unprotected surfaces of soil enclosed within the walls of buildings." In England "a bye-law is now very commonly in operation requiring that the whole ground surface or site should be properly asphalted or covered with a layer of good cement concrete rammed solid, at least six inches thick." Rush[1] laid great stress upon a "dry situation." "A damp air," he said, "whether breathed in a room or out of doors, is generally hurtful in every form of this disease. A kitchen or a bedroom below the level of the ground has often produced, and never fails to increase, a pulmonary consumption." He had "often observed a peculiar paleness (the first symptom of general debility) to show itself very early in the faces of persons who work or sleep in cellar-kitchens or shops." Thorne further calls attention to cases of tuberculosis occurring in isolated rural spots among families pursuing healthy occupations, dwelling at some considerable elevation and exposed to hill- or even mountain-breezes. "The cottages have been so built on small plateaus excavated in the hillside that the soil is in actual contact with the lower part of one or more of the external walls, the wetness of the ground around has been increased, and practically rendered constant, by the absence of eaves-guttering, with consequent saturation of the foundations by reason of the roof-water dripping on to the ground close to the walls, and the floor inside has consisted of porous brick or stone laid directly

[1] *Loc. cit.*

on a soil rendered thus cold and damp." These conditions having remained uncorrected "*from generation to generation,*" while the families continued to exhibit "a proneness to consumption," the importance of more general diffusion among physicians of a proper understanding of the subject, is so evident that I need make no apology for devoting space to it.

"Another point of paramount importance has to do with the provision of adequate open space about the dwelling-house, in order to secure (*a*) free movement of air and (*b*) ample light both within and around it. Every building should have in front of it, and extending throughout the whole line of its frontage, an open space of a minimum depth never less than twenty-four feet. To prevent the construction of courts, however wide, only approached by narrow tunnels from main streets, and hence containing stagnant air, it is necessary to require that every 'street' shall have at one end at least, an entrance of a width equal to the width of the street and open from the ground upward. Every domestic building should have a minimum of open space to the rear free from any erection. It should extend laterally throughout the entire width of each building, and also be of a definite depth across, increasing with the height of the house; thus a free circulation of air *about* the buildings is ensured. The method of building back-to-back precludes all possibility of thorough ventilation." Statistics compiled from reports by Tatham are given, showing that as the percentage of "back-to-back" houses increases there is increase in the mortality from phthisis, in general mortality, and in mortality from other specified diseases. This subject, too, is becoming of importance in American cities, not excepting Philadelphia, our proud "City of Homes," where rapacious builders resort to all sorts of devices to evade the law; and where even the inadequate space that the law requires to be left between buildings is often so cut up or so disposed as to be practically useless.

In cities there should be a sufficient number of parks and squares, properly sodded and wooded, and trees should be planted along the residence streets. A large park near the city or in its heart is highly desirable, but will not in itself take the place of a large number of smaller squares wisely distributed.

AIR.—The best air is that out of doors, already considered; but indoor hygiene must not be lost sight of. The air of the house should not be too dry—air devoid of moisture provokes cough and may cause hæmoptysis—and should be kept at an equable temperature. It must be constantly renewed—when possible through open windows. Other means of ventilation should be provided for bad weather. The house must not be too warm, as the tendency to take cold and the susceptibility to slight changes will be thereby increased. About 65° F. in

the winter is not too cold; 60° F. is usually sufficient even for a living-room; and the temperature of the bed-room, which should be occupied at night only, ought never to be above 60° F., while some will find 55° F. warm enough. When there is actual pulmonary disease, however, it may be necessary to keep the temperature of the patient's apartments at 65° to 70° F. The person's sensations are the best guide as to the proper degree of moisture. The bed-room should be high-ceiled and as large and as sunny as possible (southern exposure), and should contain several windows, by leaving which open it should be constantly ventilated during the day. It should not be on the ground floor. If there be a fire in the room, it should be in an open grate, and Richardson highly commends the use of the "Arnott valve" in order, by means of a free chimney-vent, to keep the freest possible current of air circulating through the room. The furniture should be as simple as possible. Artificial light should not be allowed to use up the oxygen needed by the patient. Electric light is thus the best, and lamp and candle are preferable to coal-gas. The patient should be the room's sole occupant. He needs all the air obtainable. 1500 cubic feet of air-space *per personâ* is a minimum. Concerning the opening of the windows at night, no invariable rule can be laid down. In winter the window next the bed should at all events be closed, and if another window in the bed-room is left open, the bed should be protected from draught by a screen or otherwise. Windows should be let down from the top—an apparently trivial matter to mention, but one too often lost sight of. A frame of boards may be so arranged inside and at the top of the window-frame, inclining from below upward and outward, as to direct the incoming air upward and protect from draught. One room cannot be ventilated into another room, but where it is possible to ventilate the sleeping chamber by opening windows in the next room and the door of communication, that is sometimes the preferable plan. Toward the small hours of the morning it is sometimes necessary to close the window, on account of a peculiar damp and penetratingly cold quality that the air, in the latitude and longitude of Philadelphia at least, exhibits at that time.

Light.—Light is no less important than air. The present tendency to the erection of tall buildings in cities is bound to have deplorable consequences, unless some proper proportion be established between the width of streets and the height of buildings permitted to be erected thereon. According to Koch,[1] tubercle bacilli are killed in from a few minutes to some hours by direct exposure to the sunlight, and die in from five to seven days in ordinary daylight. Thus we have in proper building laws, conscientiously enforced, a greater protection against possible infection of houses and rooms by these organisms than in the

[1] *International Medical Congress*, Berlin, 1890, cited by Thorne, *loc. cit.*

measures of isolation advocated to-day or the burning of furniture and scraping of walls practised in Naples a hundred years ago.

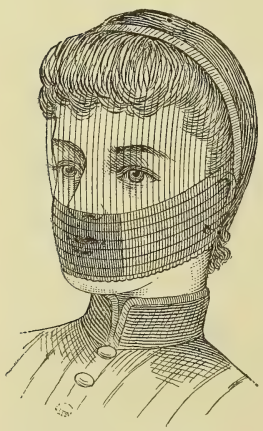
But light is still more important for the part it plays in the development and sustentation of the healthy human animal. It is not too sweeping a generalization to say that those conditions which favor the nutrition of man oppose the nutrition of harmful bacteria, and that those which favor the growth of such bacteria oppose that of man. Light and air are inimical to the tubercle bacillus. Light and air are beneficial to man. Exposure in summer to too strong a sun is of course to be avoided, but, setting aside that extreme, the more sunlight a child or an adult can enjoy, the better will his health be conserved. Thus, whether out of doors or indoors, sitting or walking or riding, the sun should be courted. Richardson says: "To fulfil the natural law regulating the times of sleep, to escape from the artificial light, and to obtain the advantage of all the sunlight that can be secured, the consumptive patient should make the sun his fellow-workman." Sun-baths, the child playing naked in the sunlight that enters a room of proper temperature devoid of draughts, are to be highly recommended. The "sun-parlors" which are attached to many hotels and sanitoria are among the most admirable provisions in the construction of such buildings. Those who have for any reason to keep indoors can here chat, read, or lounge. On wet but sunny days children can play here until the ground becomes dry enough to send them out. Porches, balconies, and verandahs are for similar reasons useful as well as picturesque features of hotel and residence architecture.

Clothing.—The general rules already laid down in regard to the materials for the clothing of infants apply as well to that of all ages. As far as possible, the stuff should be of open texture. It should be warm, but light, loose, not oppressive, and suited to the climate and season. Especial care must be taken as to the garments that are next the skin. They must permit free transpiration, and while quickly absorbing perspiration from the skin, as quickly yield it by evaporation to the outer air. Woollen or silk underwear, or the scientific mixture of wool and cotton previously alluded to, should therefore be worn winter and summer. Protection is not needed for the chest only, but for the entire body, including the extremities. For some persons woollen is to be preferred to silk—independently of cheapness—for summer as well as winter wear, on account of their tendency to profuse perspiration. When perspiration is only moderate silk is often the better. Children should not be permitted to go with bare legs or bare necks in winter. Corsets, close-fitting waists, and low-necked dresses are to be forbidden to women, and if open-necked dresses be worn, the open space should be filled with tulle, lace, or other gauze-stuff. Straps and belts about the waist are injurious. In changeable

climates and seasons the clothing, outer and inner, should be changed with the weather. A very good rule is to have a number of sizes of light-weight undershirts capable of being worn one over the other, and to wear one or more according to season and weather. One is thus always fully prepared for changes, though the cold-water *régime* ought in itself to be sufficient fortification against changes. Even in summer extra clothing is sometimes necessary in the early morning or at night. As little clothing as possible should be worn in bed, the bed-covers being varied with the necessities of the occasion. The bed should not be curtained, nor should feather mattresses be used. A hair mattress is the best, with spring cushion instead of slats or ropes for support. Brass or iron bedsteads are better than wooden ones, as they are more readily and thoroughly cleansed. A loose woollen night-gown or a woollen suit combining shirt and drawers in one garment, not too tight, is to be preferred, except in summer. The weight of this garment should vary with the season. The night-dress should be turned inside out and thoroughly sunned and aired during the day. The same garment should not be worn more than three nights in succession. It is better to have two or three for each week, wearing them on alternate nights. Similar rules apply to the day under-wear. Richardson would have the under-clothing changed daily. Even the very poorest must be made to understand that the same garments are not to be worn day and night.

Close-fitting scarfs, fur boas, and the like around the neck, buckskin and wadded flannel chest-protectors, plasters, and the like, should be strictly forbidden. The former are responsible for sore throats and bronchial catarrhs. The latter interfere with proper cutaneous action, become foul with retained perspiration, heat the breast or thorax unduly, and serve no good purpose. In windy or foggy weather, however, loose mufflers or light and simple respirators may be wisely worn by some patients, more especially those liable to "colds" and catarrhs. Nothing more is necessary than a few folds of gauzy material, or a piece of fine wire gauze cut oval and adjusted in the centre of a shawl or woollen scarf, so as to cover the nose and mouth. The scarf, without the gauze, thrown loosely over nose and mouth, as worn by hackmen, is sometimes to be preferred. For the use of women Lennox Browne has devised a veil (Fig. 148) which may be readily made at home. "It consists of a piece of plain, unspotted blonde, with a

Fig. 148.



Lennox Browne's Respirator-veil.

double thickness of silk gossamer on the lower four inches. The part that covers the mouth and nostrils is stiffened with a layer of thin wire gauze, so that the veil may stand a little away from the face and be more comfortable."

In severe weather a loose buckskin vest or vest-front over the linen or flannel outer shirt or waist is not a bad protection, but a cardigan jacket is usually much better. Extra wadding in and between the shoulders of the coat worn in the late fall and early spring, and a cape to the winter overcoat, are often judicious in our northern climates. Patients with weak circulation should be careful to wrap up well when driving, and, if necessary, to use muffs and foot-warmers. Sealskin sacques and other heavy wrappings affected by women should not be permitted to be worn. They are especially dangerous when not removed immediately on going from the street into a house, store, church, place of amusement, or other heated room. Waterproof outer garments are sometimes a less evil than a wetting, but with very rare exceptions they are disagreeable and unwholesome things, as they prevent free circulation of air about the body and surround it with concentrated dampness. For the sick they are more injurious than for the well. They should, in any event, be removed immediately on going indoors. In weather calling for such protection, however, rubber or "arctic" overshoes should, as a rule, be worn. Boots should not be worn. In winter the shoes should be sufficiently stout-soled and may be flannel-lined. It is a good plan to have separate street-shoes and house-shoes, as also to keep two pairs in service, wearing them on alternate days. Woollen stockings are preferable in winter, and silk or lisle thread in summer. Frequent change of stockings is desirable, the ordinary rules of cleanliness being best exaggerated in this as in other respects.

Food.—Chief among the measures designed to improve nutrition by adding energy to the organism is the administration of food—food in its broadest sense; that is to say, everything that the cells and tissues and organs of the body need for the performance of their metabolic functions. This includes:

First, aliment in its restricted sense; that is, construction-materials in the form of organic and inorganic food-stuffs;

Second, force-giving aliment; that is, materials that, without becoming permanently incorporated into the tissues, form therewith a transient association, and by their oxidation furnish the greater part of the circulating energy for the performance of function;

Third, water;

Fourth, oxygen.

The last-mentioned has briefly been treated of in our references to residence, altitude, ventilation, and exercise, and will again require consideration in connection with pneumotherapy. We shall therefore

simply emphasize its position as a food—respiratory diet—by its mention here, and defer detailed exposition of its use.

In diet, as in other matters, we must precede our general rules by the qualification that strict individualization is necessary. The mere whims and fancies of a patient must often be humored, and it will sometimes tax the physician's resources to the utmost to provide a suitable dietary and at the same time please his client's palate. However, a little judicious management will often accomplish much in overcoming what is merely whim; and if the inability to take certain foods or the craving for others have a physiologic or pathologic basis, these symptoms become a part of the therapeutic problem and demand special study.

One fact, however, must be given special prominence. Young girls, the subjects of hypotrophy if not of actual tuberculosis, often exhibit distaste for meat in general and for rare meat in particular, are averse to eating butter and other fats, and have a morbid craving for sweets and other indigestibles. This is one of the symptoms of disease, and is to be combated, not yielded to. The sweets are to be cut off. The necessary foods are to be given in small quantities, progressively increased as tolerance is established, and will finally be taken in proper amount and with relish. This being accomplished, the road to recovery has been fairly entered upon.

The diet of the individual in whom we are endeavoring to prevent the development of tuberculosis must differ somewhat from that of the subject of the developed disease; but, as in other divisions of the general theme, it will simplify study and reference to consider both together, indicating differences where necessary. Thus, those in whom there has been no active manifestation of disease may be allowed greater liberty, and especially in the use of cereals, and of amylaceous and saccharine foods, than can be permitted to those who have manifest lesions.

Certain distinctions in diet, too, are to be made at different ages. Of very young children we have already spoken at sufficient length. Concerning older children and adolescents it is to be remarked that the proportion of hydrocarbons and carbohydrates required and allowed is greater than after the physiologic majority (about twenty-five years for the male) has been attained.

Not only the physical and mental condition of the patient, but also his means, vocation, and avocations, the number of hours daily passed in the open air—in short, all the circumstances of his environment—must be taken into consideration in prescribing his dietary. It is to be prescribed, however, not left to chance. Sufficient latitude to permit the pleasant exercise of choice and to avoid monotony must, if possible, be allowed; but at the same time definite instructions must be

given as to quantity and quality of food, frequency, time, and duration of meals, and even, in some instances, manner of eating. A good plan is to have printed or written slips containing general rules, one of which, being corrected for the individual case, is handed to the patient. A form that I use in cases of phthisis is (with some alteration) here appended, and may serve to introduce the detailed consideration of our subject:

DIET-LIST FOR MR. ——.

MAY TAKE—*Soups, broths, purées, etc.*—Bouillon; mutton, chicken, oyster, clam, turtle, barley, rice, bean, pea.

Fish.—All kinds that are found to "agree"—boiled, baked, stewed, or broiled.

Shellfish.—Oysters, or clams if they "agree"—raw or stewed.

Meats, etc.—Beef, rare, broiled or roast; chopped-beef patties; "Hamburger steak;" lamb or mutton chop, broiled; roast lamb or mutton; poultry, roast or broiled; game (broiled or roast); sweetbreads; brain; predigested meats ("beef peptonoids," "sarco-peptones," "liquid peptonoids," Mosquera's "beef meal," peptonized beef-tea, etc.).

Eggs.—Raw (raw, beaten with whiskey, milk, or sherry, sweetened), poached, boiled.

Fats and Oils.—Mutton, beef, butter, olive oil (cod-liver oil).

Vegetables and Salads.—Greens, lettuce, celery, spinach, asparagus, cresses, cauliflower, onions, young onions, tomatoes; green peas, string beans, lentils, and other leguminous vegetables; rice, well cooked (sparingly); radishes if they "agree" (potatoes roasted in their jackets).

Cereals (sparingly).—Cracked wheat, hominy (oatmeal, if it "agrees"); Indian corn, fresh, boiled on the cob (if it agrees); wheat bread, gluten bread (Indian-corn bread, rarely), rye bread, toast, milk toast.—Bread should be at least one day old, and the quantity eaten should be comparatively small.

Fruits, Nuts, etc.—Oranges, lemons, pears, plums, apricots, peaches, nectarines, grapes (fresh figs, fresh dates), melons and all other ripe fruits that "agree" (be careful concerning apples and bananas); baked apples (sparingly); black walnuts, English walnuts, almonds, hickory-nuts, filberts, roasted or boiled chestnuts, and other nuts that "agree" (all nuts sparingly); olives (small pickles, very sparingly, if they "agree").

Drinks.—Boiled water; Apollinaris and other carbonated waters; pure water; mineral waters as prescribed (hot water one hour before meals); hot milk, cream, milk-punch, cream-punch, egg-nog; peptonized milk; peptonized milk and lemon-juice, sweetened; lemonade, orangeade, sherbet, ginger ale; alcoholic drinks as prescribed (brandy, whiskey, wines, and malt liquors); malt preparations; coffee, cocoa, chocolate (tea), coca preparations.

AVOID—Starchy, farinaceous, and saccharine foods as a rule; macaroni, spaghetti, potatoes, turnips, carrots, parsnips, beets, arrowroot (oatmeal), corn starch, sago, tapioca, etc.; all pies and pastries; made dishes, puddings, gravies, sweets of all kinds; hot cakes, hot bread. All fried food.

It is important to take food between meals and at going to bed (a glass of milk or milk-punch, or liquid peptonoids, or wine of coca should be within easy reach in case of waking during the night). Not more than (three) hours, except during sleep, should be allowed to pass without taking food.

Speaking generally, then, nitrogenous foods should form the bulk

of the dietary, hydrocarbons[1] standing next in order, and carbohydrates last. Indeed, it will often be necessary, and especially in cases of pronounced phthisis, to prohibit starches and sugars almost as rigorously as in cases of diabetes mellitus.

The importance of a highly nitrogenous diet in the prophylaxis and treatment of tuberculosis is by no means a modern observation. Earlier writers laid stress upon the fact that carnivora are less likely than other animals to contract tuberculosis in confinement. That something more than diet is at the basis of this comparative immunity is evident, however, when we consider the more remarkable freedom from the disease of the goat and of the solipedes. Something more than diet, too, is evidently the cause of the great liability of the bovine species. The artificially prolonged and excessive lactation of the female of this species has unquestionably much to do with the production of her susceptibility and that of her offspring to tuberculosis; while continuous inbreeding and the custom of stall-feeding have also considerable influence.[2]

However this may be, the flesh of this very bovine species, provided it be from a healthy animal, is by common consent, quite apart from theory, the best of all single articles of food for those of tuberculous diathesis or affection, while the milk of a healthy cow and the butter derived from that milk stand next in usefulness on the list of easily procurable aliments; for goat's milk and the milk of solipedes are not, in this country at least, readily procurable.

Entirely satisfactory reasons for the superiority of nitrogenous foods on the one hand, and the necessity to prohibit carbohydrates on the other hand, I cannot give. It is a clinical fact, attested by universal experience, that the faulty metabolism of consumptives is specially marked as to carbohydrates. Salisbury and his school,[3] with their "vinegar-yeast" theory of etiology, can plausibly explain this by the proneness of such foods to acetic fermentation. Thomson[4] believes that bacteria appropriate to themselves the nitrogen of the tissues, and that therefore proteid food-stuffs are best adapted to repair the loss. But this will hardly serve to explain the lessened favorableness of the tissues as a culture soil for fungi, brought about by increasing the quantity of nitrogenous aliments ingested. Brush[5] claims that the liability of animals to tuberculosis increases with the average of bodily temperature, that of the cow, while irregular, being always high as compared with that of man and of immune animals, such as

[1] It would of course be more correct to say oxyhydrocarbons, but I shall use the term for fats and oils that is commonly employed by writers on dietetics.

[2] *Vide* Brush, *loc cit.* [3] *Vide* E. Cutter, *Virginia Med. Monthly*, Dec., 1888.

[4] *The Histochemistry and Pathogeny of Tubercle*, Melbourne, 1876, p. 47.

[5] *Loc. cit.*

the dog and the horse. If the statistics of this careful observer are correct and his conclusions devoid of fallacy, it may be that more than he suggests is involved in his studies, and that the relations between certain foods and heat-production in man have something to do with the question.

Simplest of all explanations is that based on the fact that fermentative dyspepsia is best treated by the withdrawal of fermentable foods; but this is as inadequate as the others are fanciful.

Another empirical datum as to diet has before been alluded to, but may now be emphasized. Oily and fatty foods are hardly inferior in value to the proteids; milk, which stands second upon the list for adults and first upon the list for children, containing a decided proportion of one of the best of hydrocarbonaceous foods—namely, milk-fat or butter.

Anticipating for the moment what we shall afterward verify as to the results of treatment in general, we may arrange as follows our data, experimental and other, bearing upon this question of diet:

In those who most readily become tuberculous there is a deficiency in vital energy.

When the disease is fully established its most marked feature is wasting (phthisis, tabes, consumption), exhibiting a relative excess of katabolic processes over anabolic processes.

The most successful preventive or curative measures are those which add to the available force of the organism, either (*a*) by the introduction of energy from without, or (*b*) by the more effective liberation of intrinsic energy.

One chief source of renewal of vital energy is food.

Food-stuffs serve two main purposes—tissue-building with force-storing; and heat-production, permitting work to be done through conversion of heat without excesssive destruction of tissue.

Nitrogen compounds, as a rule, as we know them in the arts (nitroglycerin, fulminating powder, etc.) are of high potential and corresponding tension, thus being capable of sudden decomposition and yielding violent but transient effects. Carbon-hydrogen compounds, as a rule (*e. g.* coal, natural gas), are capable of slow oxidation, yielding more continuous exertion of energy, though less powerful individual discharges, than the nitrogen compounds.

Whatever, plant or animal, exhibits the phenomena of life contains nitrogen, and the proportion of nitrogen is greatest during the period of most active growth; while stored materials no longer exhibiting vital phenomena are largely carbohydrate in character in plants and hydrocarbonaceous in animals.

That tissue in animals which is most highly specialized, and that exhibits vital phenomena in the highest degree (nervous tissue), con-

tains in addition to nitrogen a hydrocarbon (or fat) and certain mineral elements.

Those tissues which the most expend energy in sudden manifestations contain the greatest proportion of nitrogen, while certain materials that circulate or furnish circulating compounds without becoming part of the tissues (*e. g.* glycogen) are carbohydrates.

There is a recognized form of disease (diabetes mellitus), known to frequently terminate in tuberculosis, that is clinically characterized by an increased excretion of a carbohydrate (glucose), and in which there is therefore either an abnormal production of this compound or a failure of the organism to utilize a normal quantity, or both; and this disease is markedly influenced in its course by withholding sugar and saccharifiable foods.

As Pavy has shown, albumen, which may be taken as a type of nitrogenous foods, contains, after the separation of urea, a hydrocarbonaceous residue. This fact may be put in apposition with experimental results that life may be maintained for much greater periods upon a diet composed exclusively of proteids than upon a diet exclusively made up of hydrocarbons or of carbohydrates.

Deprivation of fresh fruits and vegetables brings about that condition of imperfect blood-formation and low nutrition known as scurvy; hence these must contain in their salts of vegetable acids materials necessary to proper nutrition.

These data are imperfect, and therefore any conclusion drawn from them must be subject to revision; yet I believe we may provisionally, in the light of our clinical experience, reason somewhat after the following fashion:

What is deficient in the hypotrophic subject is not the great quantity of circulating energy, which may be crudely represented as extrinsic energy derived from the combustion of carbonaceous food—cell-contents, fluids, intercellular substance (?)—but the ability to utilize this circulating energy to the best advantage; and this, in turn, is dependent upon a lack of the small quantity of intrinsic circulating energy derived from the reserve store of (high potential) energy represented by the nitrogenous constitution of the molecules of cell-substance—bioplasm, nuclein (?). The charcoal of the gunpowder is there, but the nitre is deficient. If, however, there is only lack, and not absence, of bionergy, (hypotrophy, and not atrophy), there may still be sufficient to reinforce itself by the conversion and utilization of other forms of energy, provided materials of proper molecular constitution be supplied. These materials are (plausibly) best found in the nitrogenous tissues of other animals—which contain not only heat-producing constituents (Pavy's hydrocarbonaceous residue), but the material basis for the life-energy of tissue that is to render that heat of use; and, further, require less

force to be spent upon them in order to render them available for tissue-building than does any other substance to be found in nature. Hydrocarbons are preferable to carbohydrates in supplying the extrinsic circulating energy required: first, because they nearer approach the animal type of stored energy; and secondly, because, while they require less expenditure of energy in digestion and assimilation, they have a greater heat-producing value, owing to the non-satisfaction of their hydrogen with oxygen (Pavy, Frankland). The mineral salts, apart from phosphorus, lime, and other constituents of certain tissues, are necessary to the chemic processes of the body, in the same way that in the laboratory use must be made of many reagents forming no part of the final product.

This method of looking at the question is in harmony both with the great generalization of Liebig and with the limitations placed upon that doctrine by the observations of Fick and Wislicenus. It accords, too, with the opinions that Herbert Spencer's[1] profound reflection and keen discernment have led him to express concerning the importance of the high tension (relative instability) of nitrogen compounds in the molecular constitution of living substance, and of the nature of their relations (as liberators of energy) with non-nitrogenous compounds (as maintainers of energy).

In what follows, which has reference to the diet of the consumptive rather than to that of the hypotrophic subject, I shall reproduce portions of an article on "Food in the Treatment of Pulmonary Consumption," contributed by me to the Proceedings of the American Medical Association[2] in 1889:

"While it has long been recognized that nourishing food is of the greatest necessity in the management of cases of pulmonary consumption, within recent times the experience of Debove[3] has most of all contributed to the proper appreciation of this fact by the profession. It is unnecessary to do more than allude to the reports of this observer upon the value of over-feeding by means of the stomach-tube, for these reports have been abundantly confirmed by subsequent experience of competent observers in all countries.

"The great value of Debove's demonstrations, moreover, consists not so much in the method of alimentation employed—for resort to the stomach-tube may be reserved for special cases—but in the fact prominently brought forth, that many consumptives, despite loss of appetite, retain good powers of digestion and of assimilation for certain kinds of food; that, indeed, they are able to dispose of a quantity far in excess of the needs of healthy persons; and that by means of

[1] *Principles of Biology*, vol. i. chapters i. and ii., specially §§ 2 and 15.

[2] *Journal of the Amer. Med. Assoc.*, Feb. 8, 1890, p. 186.

[3] *Bull. et Mém. de la Soc. méd. des Hôp. de Paris*, 1881, *Mém.* p. 270.

this excessive quantity, this superalimentation, not only can present waste be checked, but past waste be repaired. Debove, too, indicated the most serviceable articles of food—namely, beef-powder, eggs, and milk; in other words, a highly-concentrated nitrogenous dietary.

"Some practitioners in New York have had considerable success by restricting their patients to an exclusive diet of beef, combined with copious potations of hot water. This plan, I can personally testify from examination of patients thus treated, does yield excellent results; but I have obtained equally good results in my own practice with a more varied dietary, of which, however, beef forms the principal item. It should be tender and juicy, and the removal of fibrous parts is an advantage. It may be broiled or roasted, but should always be done rare. It may be finely chopped, moulded into little patties, and broiled just sufficiently to brown the outside, then seasoned with salt, pepper, thyme, parsley, etc., to taste. It may be eaten raw if desired and if no apprehension of tænia be entertained; but there is no advantage in raw beef over rare broiled steak or rare roast. Beef should be eaten at least twice, and if possible three times, a day. When there is danger of the patient tiring of it, mutton, fowl, sweetbreads, eggs, fish, or game may be occasionally substituted." Richardson places mutton first upon the list. "Milk should also form an important portion of the dietary. The effort should be made in the majority of cases to have at least a quart and a pint of milk and a pint of cream taken during each twenty-four hours. Koumyss or some of the other fermented preparations of milk (kefir, matzoon) are often highly useful." Jaccoud says that new milk should be drunk, and in the cowshed. When the cow is known to be healthy, this is no doubt a good plan. At all events, milk should never be taken cold, but if not new it should be heated to an agreeable temperature. It must be taken slowly, by sips, and thoroughly incorporated with the saliva before swallowing. I advise patients to consume ten minutes in drinking a (half pint) glass of hot milk. "Lime-water may be added if necessary. Soups and broths of all kinds, not likely to cause indigestion and not containing any of the prohibited vegetables, may also be partaken of. The leguminous vegetables, peas, beans, and lentils, as well as lettuce, cresses, spinach, and the other green vegetables, which contain those alkaline salts of organic acids so highly necessary to the proper constitution of the blood, should be freely eaten; but potatoes, turnips, beets, and the starchy and sugary vegetables generally, should be avoided or cut down to the lowest limit. Bread should be reduced to a minimum, and gluten bread or that made from the whole wheat substituted for the ordinary white bread. Pastries, sweets, and in general those articles of diet which are indigestible or digestible only with difficulty, must be prohibited. All cooking must be as plain as possible. Frying is to be

prohibited. Articles having greatly different rates of digestion are not to be taken at the same meal.

"Although in consumption, as in diabetes and gout, the carbohydrates are not properly assimilated, yet other forms of hydrocarbonaceous food are not only harmless, but are absolutely required, The hydrocarbonaceous residue that, as Pavy has shown, remains after urea has been separated from the proteids furnishes this in part. In addition, fats in the form of oil dressing for salads, mutton fat, beef fat, and, above all, butter, should be eaten in rather large quantities. The cream already spoken of will also furnish a certain amount of fat. Cod-liver oil and oleaginous inunctions may be resorted to when necessary. Alcohol as a diffusible hydrocarbon, assimilable without digestion and readily oxidizable, plays the part of a food as well as that of a medicine in this affection, more especially in febrile cases. It is best given with some other food, as milk, cream, eggs, or cod-liver oil. In some cases, for prudential reasons, it may be disguised as malt extract or made into a prescription with glycerin, as advised by Jaccoud. From one to eight ounces of alcohol daily may be given, according to indications. Water should be taken freely, and hot water, a pint or so an hour before each meal, does certainly help to prepare the mucous membrane of the alimentary canal for the reception and proper disposition of food, as well as assist in passing off through the kidneys the greater amount of certain of the waste products of metabolism consequent upon the character of the diet.

"The frequency of taking food should not be left to the whims or discretion of the patient. Everything should be accurately prescribed, not only as to quality and quantity of food, but also as to the exact times of eating. Individualization in special character of food and in special time of meals is as necessary as individualization in selection and dosage of drugs. Here, however, we can speak in general terms only. The American custom of three stated meals daily is a good one. In addition, food should be taken at suitable intervals between the stated meals and at bedtime. Rarely more than three hours, never more than four hours, except during sleep, should elapse between the times of taking food; and not only should a glass of milk, cream, or milk-punch be taken just before going to bed, but there should be something of the kind, or perhaps a glass of wine or spirits, with some suitable meat preparation, like liquid peptonoids, by the bedside within easy reach of the patient in case of waking during the night or early morning.

"When digestion seems to be impaired, or when a sufficient quantity of ordinary food cannot be taken, or when for any reason it is desired to save for other purposes part of the energy that would be required for digestion, predigested foods may be employed.

"The milk used by the patient may be partially peptonized, or the alkaline pancreatic preparation simply be added to it at the moment of drinking, the peptonization being thus artificially effected within the alimentary canal. Peptonized beef-tea—a preparation which, unlike ordinary beef-tea, is a true food—may be prepared at home, or some of the excellent preparations of predigested beef that are now on sale at the shops, may be obtained. Of these preparations I have derived most satisfaction from the use of Reed & Carnrick's 'beef peptonoids,' of which from one ounce to four or five ounces daily may be given, according to indications. It may be made into a paste and spread upon bread, or added to hot water, soup, hot milk, or milk and alcohol. I prefer the latter methods." Mosquera's "beef-meal" will probably prove even better. According to Chittenden,[1] if we represent by 100 the nutritive value of lean beef, that of "beef-peptonoids" will be 140, and that of "beef-meal" will be 400. The last-mentioned preparation has the further advantage of containing no carbohydrate, which in certain cases may be of great importance. For persons sent upon sea-voyages or other prolonged journeys, and for those who reside or sojourn in places where fresh beef cannot readily be obtained, these commercial foods are of great assistance. "Malted milk" is likewise of great use during travel.

"We may thus outline an ordinary routine susceptible of modification with the season and according to individual taste or circumstances. A midday dinner is usually preferable to an evening one, for outdoor exercise is necessary to assist the digestion of the principal meal of the day. The patient should drink a pint of hot water on awakening in the morning, and a little later (after his bath) take a glass of milk-punch with a table-spoonful of beef peptonoids. An hour or so after this follows breakfast, consisting of rare broiled beefsteak, or mutton chops, broiled fish, or eggs boiled or poached, with coffee or chocolate if desired, milk, sliced tomatoes or other seasonable vegetable, a moderate amount of bread, with a great deal of butter. If much desired, a dish of gruel or porridge, preferably cracked wheat, may be allowed. Two or three hours later, koumyss or soup, or broth strengthened with beef peptonoids, milk, butter and bread, celery and a salad of greens, follow. At one o'clock a substantial dinner is eaten, of which bouillon, with or without beef peptonoids, is the first item, and rare roast beef the principal dish; the meal consisting in addition of the allowable vegetables, especially the greens; and when possible a glass of burgundy or other generous red wine or good wine of coca, or even a glass or two of beer, is taken during the meal. Fruits are the only permissible dessert. Dinner should in many cases be preceded by the drinking of hot water, half a pint to a pint, half an hour to an hour

[1] *Trans. Philada. County Med. Society*, 1891.

before eating. Hot lemonade is sometimes more agreeable. At three or four o'clock comes koumyss or cream, or milk-punch with peptonoids, or malt extract; at six or seven, supper of a character similar to the breakfast; at nine, or at latest ten o'clock, bedtime, the patient drinks cream with coca, coca wine, or milk and liquid peptonoids, with or without coca; while coca wine or milk or cream, with or without alcohol and peptonoids, is placed within easy reach for use on waking during the night. Cold water may be taken at suitable intervals between meals, never with meals.

"While the digestive apparatus is not to be burdened beyond its capacity, the object is distinctly cramming—over-feeding; and when it cannot be properly carried out in some such manner as this, the tube of Debove should be used without hesitation. For artificial feeding, peptonized milk, with beef powders, leguminous powders, predigested cereal preparations, or raw eggs, should be employed. Alcohol and the digestive ferments may also be added when indicated. About a quart should be introduced into the stomach at each feeding, and not less than two feedings a day be practised. The patient may also be allowed to eat, or to drink nutritious liquids, in the intervals. When gavage is practised, it is well to precede it by lavage with alkaline solutions, to which a little chloroform-water has been added.

"In order to enable the patient to digest and to assimilate this excessive amount of aliment the alimentary canal and its adnexa, immediate and remote, must be put and kept in good condition, and a proper supply of air must be afforded. This we have spoken of as the 'respiratory diet.' Arbuthnot's characterization of respiration as the 'second digestion' cannot be too often quoted. In a few cases of comparatively early date the institution of appropriate voluntary muscular exercise, both indoors and out of doors, will accomplish all that is necessary in this direction. In the majority of cases, however, artificial aids to respiration are necessary."

WATER.—*As a Food.*—The inclusion of water in food-stuffs is not novel, but a few supplementary words in relation to its true place should be said; the more so that patients are often either neglectful of this simple matter or inclined to magnify its importance. The large proportion of water contained in all forms of protoplasm is a sufficient indication of its necessity to life. The difference between a living muscle and a desiccated muscle, or between a green leaf and a dry leaf, is sufficiently striking to require no other comment than its mention. The activity of protoplasm being manifested by a constant flux of its constituents, a medium for that flux is an absolute necessity. Furthermore, the cells of the body are aquatic in their habit. According to Genesis, as according to science, the lowly forms in which life first resided had their origin in the water: and in the fluid lymph of

the intercellular spaces or in the serum of the circulating tissue still live the cells that make up the tissues and organs of the highest forms of life. Thus in all conditions in which it becomes necessary to stimulate the activities of bioplasm, the function or the nutrition of cells, it is important to provide a due supply of fluid. Especially in the treatment of a disease like the one under consideration, where the therapeutic object is to carry to the cells all over the body the greatest amount possible of new material for anabolism, and to remove from them as perfectly as possible all waste products of katabolism, is this necessary; and for that reason we lay more than ordinary stress upon the due supply of water. Much of the therapeutic efficacy of medicinal infusions and decoctions, and many of the vaunted virtues of much-advertised mineral springs, are due to simple hydrogen monoxide, and not to the drug of the infusion or the saline constituents of the spring-water. In conditions involving no organic disease of the kidneys or heart there is no diuretic equal to water, and it is often of service in supplying the loss by morbid perspiration. Inquiry must be made as to its use, and due prescription given when needed.

External Application of Water.—We have already spoken of the daily cool or cold sponge-bath. This is to be gradually supplemented with measures that may justly be termed hydrotherapeutic—namely, the cold shower-bath and the cold douche. The details of the therapeutic application of water, its physiologic effects, the character of the reaction in various individuals, and other important practical points being fully treated in a special article by a recognized authority, we may here be brief and general.

Jaccoud[1] advises that immediately after rising a cold shower-bath should be taken in the form of a gentle rain, accompanied by a larger jet of water. This should be continued for a very short time at first, twenty or thirty seconds, the time being gradually prolonged to a minute or more, according to the character of the reaction. The shower-bath is to be immediately followed by forcible and dry friction, and the patient, when dressed, after having drunk one or two cups of milk, should take a walk, uninterrupted, but not long enough to produce a feeling of fatigue. In place of the walk, especially in the city, and in the country in unpropitious weather, indoor exercise, gradually increased in activity, may be substituted. It should preferably be such as to require locomotion, and the outer clothing should not be donned until it is concluded. The windows should be opened if not forbidden by weather. From five to ten minutes is a sufficient time. Richardson[2] advises daily bathing, by immersion or sponging, simply for the sake of cleanliness and the proper cutaneous function thereby assured. He would have the water tepid (five to ten

[1] *Op. cit.*, p. 97, *et seq.* [2] *Op. cit.*

degrees below the body temperature), and the stay therein merely sufficient to obtain a free ablution. He attributes no therapeutic virtue to cold water or to the impact of douche or spray. In this my experience leads me to differ with even so great a teacher as the Humboldt of medicine. The cold shower-bath not only protects against chill, stimulates the skin, and produces a general reactionary activity in the organic functions, but it is of special service as a respiratory tonic. The shock occasioned by the first contact with water causes one to "hold his breath." This is immediately followed by a prolonged expiration, and this in turn by a deep inspiration; so that a habit of full breathing is formed. In those who react well from the shower-bath cold douching with a stream of considerable size may be added.

Less effective than the shower-bath is daily cold sponging, salt, vinegar, or alcohol being added to the water. An evening sponge-bath, just before going to bed, is desirable, but not indispensable. Plunge-baths, preferably cool, should be taken at suitable intervals, and may be taken daily instead of the sponge-bath, and just before the shower-bath, by those who prefer this method.

Delicate and sensitive persons coming under treatment without having been previously inured to the cold bath must be accustomed to it by gradual changes. At first, tepid lotions or sprinkling with tepid water should be prescribed. The temperature of the water should then be gradually reduced until on rising in the morning the patient sponges his body with water that has stood in the room over night, and is therefore at about the temperature of the atmosphere. The reaction to this is the guide to the institution of the more powerful hydrotherapeutic measures. Having begun these latter tentatively, it is necessary, as Jaccoud points out, not to be deceived by a temporary reaction immediately following the shower-bath, or at all events after a few minutes' exercise, which, however, gives place after the walk to a distressing sensation of cold. In such cases progress must be very careful and gradual, and finally the ability of the patient to bear the complete method of treatment may be looked upon as an evidence of beginning recovery. Cool bathing, if begun in summer, may oftentimes be continued into the winter by a patient that would not have been able to begin in cold weather. In some cases, too, we shall have, though reluctantly, to be satisfied in winter with tepid baths and lotions, the other measures being used only in mild weather.

Exercise and Rest.—Muscular exercise becomes more and more important as the infant develops into the child, the child into the youth, the youth into the adult. Daily walks and the romping of healthful, not too violent, sports are perhaps included in the advice to keep in the open air.

Jaccoud[1] advises that, where the character of the country permits it, ascents proportionate to the age and strength of the individual should be prescribed. These ascents should be made with slow and measured steps, in order to avoid fatigue to the respiratory organs; and there should be occasional rests by the way.[2] To expand the lungs as much as possible, especially while climbing, the elbows should be made to approach each other behind the back, and a walking-stick be supported between them; or the arms may be folded behind the back, with or without a stick being thrust through. Even without this the head and trunk should be kept erect and the shoulders well thrown back.

Whether walking on a level or climbing the patient must be instructed to breathe deeply and slowly. He must take a long breath, hold it as long as possible without causing distress, and let it out slowly. The necessity for full breathing must be impressed on the care-takers of children. Rush and Ramadge advised running as a means of inducing panting, and finally proper breathing. Walking in the city is not so pleasant as in the country or by the sea. When there is a park within easy access, like Fairmount to Philadelphia, one may ride thither, walk therein, and ride home. When a patient—that is, one with actual pulmonary disease—walks in the city, it is well to walk on a street in which there is a car-track, and in the opposite direction to the cars, so that if fatigued it will be easy to ride home. Walking or other exercise—let it be repeated—whether for prophylaxis or for cure, should never be permitted to pass the point of gentle and pleasant fatigue. A wealthy patient in the city or country may have his carriage follow him while he walks. Riding on pony-, donkey-, or horse-back, on tricycle or bicycle, is also a good form of exercise. "One brisk ride is (sometimes) worth a dozen lazy walks;" and Sydenham, echoed by Rush,[3] declares a journey on horse-back to be a sure cure for consumption. "There are two methods," Rush says, "of riding for health in this disease. The first is by short excursions; the second is by long journeys. In slight consumptive affections, and after a recovery from an acute illness, short excursions are sufficient to remove the existing debility; but in the more advanced stages of consumption they are seldom effectual, and frequently do harm, by exciting an occasional appetite without adding to the digestive powers. They, moreover, keep the system constantly vibrating by

[1] *Op. cit.*, p. 99.

[2] What appeared to me to be one of the best features I saw in Brehmer's admirable sanitorium at Görbersdorf is the system of graded walks laid out at varying angles of inclination in the mountain-park, with benches at short intervals, so that no one may be fatigued by walking too far before coming to a place of rest.

[3] *Thoughts upon the Cause and Cure of Pulmonary Consumption, Medical Inquiries and Observations*, Philadelphia, 1805, 2d. ed., vol. i. p. 207; *An Inquiry, etc.*, ibid., vol. ii. p. 134, *seq.*

their unavoidable inconstancy between distant points of tone and debility, and they are unhappily accompanied at all times, from the want of a succession of fresh objects to divert the mind, by the melancholy reflection that they are the sad but necessary conditions of life. In a consumption of long continuance or of great danger, long journeys on horseback are the most effectual modes of exercise." Richardson[1] prefers walking to riding, and tricycling to either. One objection to cycling is that some machines seem to necessitate too much stooping on the part of the rider, and round shoulders may be thus produced. Driving is an agreeable variation, and when there is positive lesion or in the case of very weak persons, is often better, at first, than walking or riding. Beddoes strongly advised journeys in an open carriage: and H. I. Bowditch,[2] in his interesting report of his father's case, and of the life of his father's children, has strikingly shown not only the power of persistent life out of doors in the prevention of tuberculosis, but also the possibilities of carriage-travel as a curative measure. In this method of journeying we secure a constant renewal of air and a judicious mingling of rest with exercise. When cure comes to be considered, moreover, the question of rest will assume still greater prominence than in the discussion of prophylaxis, and the desirability of the various forms of exercise be modified accordingly. Rush[3] advised that "in the use of each of those species of exercise" he had commended—["1. Rocking in a cradle, or riding on an elastic board, commonly called a chamber horse; 2. Swinging; 3. Sailing; 4. Riding in a carriage; 5. Riding on horseback; 6. Walking; 7. Running and dancing"] "great attention should be paid to the *degree* or *force* of action with which they are applied to the body. For example, in riding in a carriage the exercise will be less in a four-wheel carriage than in a single-horse chair, and less when the horses move in a walking than a trotting gait. In riding on horseback the exercise will be less or greater according as the horse walks, paces, canters, or trots in passing over the ground." He continues: "I have good reason to believe that an English sea-captain, who was on the verge of the grave with the consumption in the spring of the year 1790, owed his perfect recovery to nothing but the above gradual manner in which, by my advice, he made use of the exercises of riding in a carriage and on horseback. I have seen many other cases of the good effects of thus accommodating exercise to debility; and I am sorry to add that I have seen many cases in which, from the neglect of this manner of using exercise, most of the species and degrees of it have either been useless or done harm. . . . . I conceive no direction to be more necessary in the cure of consump-

[1] *Op. cit.*, p. 106.

[2] *Trans. Amer. Climatological Assoc.*, 1889; reprint, Philada., 1889.

[3] *An Inquiry, etc., op. cit.*, vol. ii. p. 130.

tions. I have been thus particular in detailing it, not only because I believe it to be important, but that I might atone to society for that portion of evil which I might have prevented by a more strict attention to it in the first years of my practice." Rowing and skating should be mentioned as pleasant and useful forms of outdoor exercise; and Williams[1] highly commends tobogganning, of which the benefit depends "not on the swift and exciting descent of the snowslope, but on the slow and gradual ascent of the hill in returning." J. Solis-Cohen[2] recommends "skipping back-door" with the jumping-rope.

Calisthenic and gymnastic exercises, suited to the age and strength, should be early instituted, and persisted in, if possible, throughout life. In bad weather, or when from any other reason exercise out of doors is impossible, they are indispensable. The room should be large, cool, well lighted, and well ventilated. The exercises should be such as to favor general muscular development, more especially, however, that of the auxiliary muscles of respiration, thus ensuring full expansion of the chest during exercise, and also the acquirement of a proper respiratory habit. Still, "violent and unequal exertion of the upper muscles of the body" is wisely reprobated by Richardson.[3] This subject being clearly and fully discussed elsewhere in this SYSTEM, we need not here enter into details.

In those too weak to undertake active exercise a beginning may be made by passive exercise or massage. Billiards, bowling, and other indoor games involving general activity, in properly lighted and ventilated rooms, furnish admirable combinations of entertainment and exercise.

The time devoted to exercise, active or passive, indoors or out of doors, will vary according to circumstances. It is desirable that from ten minutes to half an hour daily should be spent in gymnastic exercises; and some three hours or more daily in the open air, driving, riding, walking, or playing. "In damp days, when walking out of doors is impossible, the consumptive child may have three hours' dancing with advantage; not in stuck-up bowing and scraping, ... but in good active dances that make every limb tingle with pleasant fatigue" (*Richardson*).

The time and character of exercise should be definitely prescribed, and not merely in the way of general directions or in the general terms here necessarily used. The peculiarities of the individual case and the circumstances of the individual environment must be carefully considered. In summer the morning and late afternoon are the best periods of the day for outdoor exercise. In cool or cold weather the middle of the day is to be preferred. Due reference must be had to the time and character of meals. After a light meal exercise may be soon under-

[1] *Op. cit.*, p. 354. [2] *Loc. cit.* [3] *Loc. cit.*

taken. After a heavier meal some two or three hours should elapse. It must be remembered, however, that calisthenics is auxiliary to open-air exercise, and not a substitute for it. Beddoes may again be profitably quoted: "The dumb-bell I consider as a miserable substitute for running, digging, working with tools, and those other exertions that engage the mind while they put the limbs into motion. Curious sports, such as archery, have not a permanent interest. They do not incorporate into a system of actions for life. *Task*-exercises, in my opinion, hold the same proportion to health as the castigations of penitents to piety or virtue."

We cannot too often remind ourselves that REST is the necessary complement to exercise. We have placed over-exercise and exhausting, unresting labor in the category of excesses; we might legitimately have exhibited the reverse of the medal, whereon "want of rest" is inscribed among privations. For rest, physiologically considered, is not merely a negation of action. It is, in our artificial distinctions, a concomitant of the negative phase of bionergy; but it is none the less a positive requirement. If there were no valley there could be no hill. As has been stated, rest becomes of greater prominence in the treatment of developed disease, more especially in febrile cases, but it is none the less important as an element of prophylaxis. Rest is the physiologic preventive of exhaustion. It permits anabolergy to restore the molecular conditions that have been changed by katabolergy. Proper exercise strengthens through use both structure and function, but only upon condition that the anabolism it stimulates has time to rebuild the tissues. I advocate, whenever possible, division of rest between night and day, waking and sleeping. When this is not possible—and, according to Richardson, in all cases—activity should be constant during the day, and rest be taken during the entire period of the sun's absence. But the important point is that there may be sufficient time of "excess of income over expenditure."

Rest must therefore be prescribed in definite qualitative and quantitative terms equally with exercise. In some cases, especially those of anæmic girls in whom there is little or no pulmonary lesion, the plan of treatment known as the "rest-cure," or, from its illustrious author, the *Weir-Mitchell* treatment, will do much more than can be accomplished by any other therapeutic measure. Rest in the moving carriage, in the easy-chair, in the hammock, or upon the grass, in open air and sunlight, is often advisable. Rest upon the deck of a vessel or by the seashore, breathing in the refreshing, stimulating, health-bringing breezes, or rest among the pine trees, inhaling their fragrant and restorative emanations, may be prescribed with advantage. But rest in the house, in the shade, and in the darkness must not be forgotten.

Too much time should not be passed in bed. Children require

more sleep than adults. Their morning or afternoon nap may sometimes be taken out of doors, especially in the moving baby-carriage. Until more than halfway toward their teens, they should not sit up later than six or seven o'clock at night, and eight o'clock is not too early for a child of ten years to go to bed. Above all things, studying by artificial light must be forbidden. Lessons should at first be few and simple, teaching being done at home as long as possible. Before books are given to the child let him be trained to observe nature. Throughout life let the stories of the rocks and of the springs, of the plants and of the birds, and other knowledge that may be gleaned in the woods and in the fields, take precedence over the learning of the school-room and of the library. The best time for such study as may be permitted is in the early morning, and both children and adults should rise early for their baths and morning walks.

Something must be said here about the tendency to undue intellectual activity upon the part of certain children of tuberculous diathesis. They are precocious, of quick apprehension, amazing understanding, and retentive memory. They love "a quiet corner and a book," and are averse to romping and to out-of-door sports. Such children, if of an intellectual ancestry, are too often encouraged in their studious habits. They should, on the contrary, be driven out of doors, and books be given to them only as a reward for some special rough-and-tumble exercise, and then but for a limited time. They should not be sent to school, in order that rivalry, emulation, the pride of teachers, or the vanity of success shall not be among the temptations luring to study. They should never be allowed to compete for prizes save in athletics, though here, too, caution is necessary against overstrain in some unsuitable exercise. These children, however, are by no means confined to cultured, or even intelligent, families. Often in a rude, vulgar, and unlettered household one will see a child of peculiarly refined and delicate appearance and corresponding mental qualities—more often a girl than a boy, I think, but I have no statistics. Such a child is almost invariably a candidate for tuberculosis.

One of the portraits of the poet Keats is strikingly illustrative of this type of the strumous constitution; and I have met with an instance in a man of exquisite poetic gifts, whose parents and brothers, though hardly to be called vulgar, were certainly commonplace. In cases of this nature sensitiveness of mind and instability of body seem intimately related.

It is important to bear in mind facts of this kind, because individual peculiarities, physical and mental, and environing circumstances, must have weight in determining the measures to be taken to prevent the potentiality of tuberculosis residing in these subjects from becoming actual disease. Not only must they be compelled to strengthen by exercise the body, and allow the mind by rest to acquire greater weight,

if less velocity, but they must be carefully protected from dangers on the emotional side of their highly sensitive psychic organization. The earlier such a child can be taken in hand the better the prospect of success. In many cases the tendency to tuberculosis can be overcome. In all the outbreak of disease can be postponed. In some cases, however, the sad fact must be recognized that there seems a time-limit to viability, and when that limit has been reached the organism goes to pieces—if not by tuberculosis, then by some intercurrent accident, such as typhoid fever.

To return now to the consideration of the time to be devoted to sleep: Jaccoud believes that a young adult or adolescent should not remain in bed more than seven hours, or at the most eight hours. Richardson, on the contrary, would send patients (at least those with overt disease) to bed at sundown; though he would, it is true, have them rise again with the sun and remain active until it sinks below the west. But here, too, we must individualize. For many, ten hours—say from nine o'clock at night to seven in the morning—will not be too much sleep. As soon as the patient is washed and dressed he should leave his room, and on fine days go at once into the open air. Even in the city Richardson would have his patients out in the street in summer by four or five o'clock in the morning. He cites Bodington's statement, that "the profuse nocturnal perspirations are soon subdued by this method of treatment, and the debility they occasion avoided. The skin assumes a healthier action in proportion to the extent of exposure to the external atmosphere, particularly to the morning air." After the morning walk, and breakfast following at an interval which depends both upon the "satisfying" qualities of the milk taken before going out and upon the digestive powers of the individual, and a rest of some half an hour for digestion's sake (during which he may read his mail or the morning's news if sufficiently near civilization), an hour or two (nine to eleven) may be spent in study, recitation, reading, writing, or other intellectual pursuit, according to the age or vocation of the individual. This may sometimes be well carried on out of doors, though there is no objection to spending the time indoors in a room sufficiently large, well lighted, and airy. Another hour may be spent in the open air if the weather, season, climate, and other conditions permit. And here it may be well to interpolate that while undue exposure to wind and storm is to be avoided, yet as a rule doubt as to the advisability of going out should be resolved in favor of going. For this opinion, which is founded upon the teaching of my preceptor and confirmed by my own observation, I am glad to find support in the experience of Bowditch,[1] who, in common with J. Solis-Cohen[2] and others, suggests that a respir-

[1] *Op. cit.*

[2] Personal teaching and *The Throat and the Voice*, Philada., 1879, p. 20.

ator may be worn, if necessary, to protect the air-passages against winds or a very cold atmosphere. Richardson[1] too declares that inclemencies of the weather "are not so much to be dreaded as confinement in a house," and advises "every patient to seize, even on an inclement day, each gleam of sunshine for the purpose of getting out for a breath of fresh air." Patients once encouraged to adopt this practice will soon realize its benefits, and need no urging to continue.

After luncheon or midday dinner there should be a partial or complete rest of from an hour and a half to three hours, part or all of which may be spent, if needful, in sleep; but sometimes better in lounging or in light reading, chatting, or other unfatiguing mental employment or amusement. The afternoon walk or ride or row, or game of ball or of croquet or of lawn tennis, may occupy the next hour or two. According to circumstances, the afternoon glass of hot milk or cup of bcuillon will be taken before, after, or during exercise. If the exercise is to be walking or riding, the food may be taken in the midst; but if it is to be more active and less easily interrupted, the nutritive drink should be taken at least half an hour before beginning the game or whatever it may be. If the outing or exercise be sufficiently prolonged, so that there is a due digestive interval, another glass of milk may be taken at its conclusion. After dinner or supper, as the evening meal may chance to be, there should be rest from all but entertaining activity.

Entertainment, amusement, enjoyment, agreeable occupation of the mind and senses must also be prescribed by the physician. Enlivening companionship and conversation, books and music, visiting and receiving visits, all ennobling pleasures or wholesome sports and games, in doors and out of doors, dancing, lecture-, theatre-, and concert-going in moderation (for crowded rooms, late hours, and the overheating of excessive dancing are prejudicial), and, in short, whatever tends to keep a cheerful mind in the sound body, have distinct usefulness as therapeutic agents.

Care must be exercised, however, even in the matter of books and music. "Exciting romances, filled with the narrations of deep and fiendish plots or hyperpoetic sentiments are quite out of place, for they, through the mind, influence respiration to the detriment of the physical forces of life. So also do dull, monotonous, whining, terror-striking treatises of whatever kind. But the book which is amusing, and which with easy efforts raises the hearty laugh at an innocent picture, or the book which carries the reader along the page of history with gentle carriage, or tells of natural facts in natural language,—this is the book to be sought for."[2] Singing and reading aloud are useful prophylactic exercises. They must be easy in method, and not

[1] *Op. cit.*, p. 100.

[2] Richardson, *op. cit.*, p. 122.

carried, either in time or exertion, to the point of fatigue or the production of hoarseness. Playing on wind-instruments, with the exception of the "mouth-organ," is to be forbidden. Playing on stringed instruments may be permitted under the conditions of non-fatigue, easy position, light, well-ventilated rooms, and so forth, already laid down at length.

Sketching, whether as a serious art or as an amusement, is a pursuit to be encouraged, if it takes and keeps one out in the open air. Caution must be observed, however, not to sketch in places that, although picturesque, are unwholesome.

Among the attractions of certain health-resorts, mountainous and other, are hunting, fishing, boating, and the like. These, combining amusement with open-air exercise, are often of decided benefit. While from an ethical standpoint I regard hunting for sport as a pursuit for barbarians, and not for men claiming to be civilized, yet the "camping-out" life is to be highly commended, provided the individual is able to "rough it," and provided the climate is as suitable for that mode of health-seeking as, for example, certain regions in the Adirondacks. *Per contra*, confinement and close and prolonged attention to lessons or work requiring decided intellectual effort, or necessitating sitting or standing in the one place or position for a long time, or in which the individual is bent forward continuously over desk or workbench, are harmful and should be avoided. The harm is greater if these occupations be carried on in crowded, overheated, poorly-ventilated, dark or dusty rooms, whether at home or at school or at college, or in office, in laboratory, in counting-room, or in factory. We are speaking, of course, of the early period of life, or of those persons who are able to regulate at all periods the time and nature of their work and play. Those who either from childhood, or when they have advanced to the period that the life-work must be taken up, are compelled, through the stress and struggle of their competitors and of the world at large, to occupy their time according to their necessities and not according to the rules of hygiene, form, unfortunately, the bulk of humanity.

To summarize and illustrate what has been said or will be said under various headings as to division of time, we may thus sketch a day in July as spent in the Pocono Mountain region of Pennsylvania by a congenitally hypotrophic young man aged seventeen or eighteen years, who has, however, been kept in good trim by preventive measures instituted at birth and continuously persisted in. He rises at 6 A. M., takes a shower-bath, drinks a glass or two of hot milk, and takes a walk, returning for breakfast about 7.30. After breakfast he reads for two hours, then again goes out, walking for a while, sitting under the trees for a while, reading at times; and while out takes, at about 10.30, another glass of milk. At 12 he returns for luncheon or midday din-

ner, which he gets about 12.30, and then naps, lounges, reads, or writes until 3.30 or 4, when he takes hot milk again, and goes out of doors to a game of tennis. At 6.30 he takes dinner or supper, and spends the evening indoors playing chess or whist. Or he may ride or row in place of his forenoon's walk or of his afternoon's game, or perhaps take part in a concert or amateur theatricals in the evening. At ten, or if very late half-past ten,[1] he goes to bed, first, perhaps, taking a cool or tepid sponge-bath. After the bath he drinks another glass of hot milk, and sleeps peacefully until the time for rising the next morning.[2]

[1] Those having actual lesions should go to bed much earlier than the time given here.

[2] In illustration of the oft-repeated advice as to the necessity of individualization, I have thought it well to append a letter from a patient, giving an actual record of mountain-life in the Adirondacks:

"I lived in the high mountainous region of the west at the foot of Whiteface, which differs in its physical features from the lower lake country farther to the west. My first trip lasted from the 1st of June till the middle of September. This includes the whole of the summer season proper. There are always frosts early in September, occasionally in August. I lived on a farm at North Elba, a mile from Saranac. As to my general mode of living, I availed myself of the advice of a farmer who has lived twenty years in the country, and who had been cured of phthisis after a residence of three years. I got up at seven o'clock, and after a sponge-bath (tubs and shower-baths are scarcely to be had there), I walked not more than half a mile on a level. Breakfast followed at 7.45, at which brook trout were usually served, with new milk and baked potatoes. After breakfast I walked and lounged around, preferably in the woods, often carrying a book, until noon. Trout-fishing in the Au Sable was an alternative. I have often waded two hours waist-deep in the stream, and walked back a mile to the farm-house in wet trousers, without any ill effect following. In harvest-time I worked in the field every morning for a week, pitching grain. Dinner was served at one o'clock; after dinner a nap of an hour in a hammock. The afternoon was given up. Every afternoon at five o'clock I walked a mile to get the mail. Tea was served at six o'clock. Weather permitting, I sat on the porch, wrapped in a light overcoat when it was necessary, until nine o'clock; bed at ten, and very welcome, too.

"I made occasional fishing-trips of a couple of days to some neighboring lake, and in September a ten-days' hunting-trip.

"In the summer months it is quite safe to sleep out of doors wrapped up in a woollen blanket on a bed of balsam boughs covered with a rubber blanket, under the shelter of a leaning shed of bark called a lean-to.

"I wore a woollen suit and flannel shirt and light merino under-clothes. Strong laced shoes are better than boots. The only weight I carried was a rifle. While in the woods we had abundance to eat—trout and venison, butter and eggs, oatmeal, rice, buckwheat cakes and biscuit—which the guide cooked in a portable tin oven—and coffee. Constipation is almost sure to follow for a few days. I was warned about it, and took some purgative pills, which I found use for. A boating-trip is easier to make and more luxuries can be taken, but I am inclined to think that the real wood-life is more beneficial if it can be endured. One gains in weight much faster in camp than at a hotel or farm. Guides can be hired at three dollars a day. Provisions ought not to cost more than three dollars a week.

"I had one experience at mountain-climbing. I found it hard work and nothing more.

"A lymphatic swelling on the neck as large as an English walnut, was entirely cured without the use of drugs by this stay of three months and a half. I have no

I do not wish to be misunderstood as recommending for any one, hypotrophic or orthotrophic, a life of "gilded idleness." It is better, when at all possible, for a consumptive to keep employed than for him to remain idle.[1] At certain junctures everything must be abandoned except the pursuit of health, but the endeavor should be made, after a reasonable time, to return to the busy world and to work in moderation. The life we have sketched will not do for a whole lifetime, save in the case of artists, writers, scientific investigators, or others whose work goes with them wherever they go. Those who cannot live except in certain climates should find occupation in the chosen place of residence, as many physicians have done.

When the vocation for life is chosen, it ought to be one that will keep the person out of doors as much as possible. The travelling salesman, if he avoid alcohol, will be better fitted to cope with disease than will the clerk; the farmer or the surveyor, than the mill-hand or the shopkeeper. Even in cities the milkman, for example—if he has not to go out too early in winter—has a better chance for escaping phthisis than has the barber or the shoemaker.

Rush[2] relates, among other instances, one told him by Franklin, of a New England post-rider that had been bred a shoemaker, and from confinement had contracted consumption, for which his physician advised horseback exercise. "Finding this too expensive, he made interest upon the death of an old post-rider to succeed to his appointment, in which he perfectly recovered his health in two years. After

record of gain in weight, but it was certainly very considerable, as shown by the surprised exclamations of my friends when they first saw me on my return.

"When you sent me back two years later, it was in the fall (Oct. 1 to Nov. 15), and my life was somewhat different.

"The hour of rising was eight. I took a glass of new milk on getting out of bed. The chest only was bathed, because of the lower temperature of the sleeping-room. After a few turns around the porch breakfast was taken at 8.30. The morning was spent in driving or in short walks. We dined at one o'clock, after which came driving or walking again; tea at six, and bed at nine. I was not out of doors after six o'clock. There was an abundance of milk, which was my chief article of diet. The food in general was not good; there was not enough meat and too much starchy food. My winter clothes (those you have seen) were necessary during the time I was there, and they would have been quite insufficient for the winter months, when a fur coat is almost a necessity.

"I took Dr. Trudeau's advice to be out of doors in spite of the weather, well protected of course. No ill effects followed from exposure to rain and snow."

[1] Richardson (*loc cit.*) relates the case of a man belonging to a phthisical family, whose brothers gave up work and died. This patient expressed a determination to "die in harness." Living in a suburb, he was compelled to pass a certain part of every day in the open air going to and from his business. It is to be presumed that the general rules of hygienic treatment were carried out, and that the patient's means enabled him to obtain all that was required in the way of nourishment and comforts. He recovered perfectly.

[2] *Thoughts, etc., op. cit.*, p. 206.

this he returned to his old trade, upon which his consumption returned. He again mounted his horse, and rode post in all seasons and weathers, between New York and Connecticut River (about 140 miles), in which employment he continued upward of thirty years in perfect health."

I know of the case of a well-educated man who was compelled by the constant recurrence of alarming pulmonary hæmorrhages to abandon professional life, and at last, fortunately before it was too late, obtained employment in the suburbs of Philadelphia as canvasser and deliverer of goods for a firm of grocers. Driving a light wagon, he kept out of doors in the pure air of Germantown and Chestnut Hill in all sorts of weather, completely recovering and preserving his health.

There are certain occupations that increase the danger of becoming tuberculous, independently of their sedentary or non-sedentary nature; thus stonecutters, steel-grinders, hatters, weavers, paper-makers, and others exposed to the inhalation of various kinds of gritty particles and irritating dust—gilders,[1] laundresses, firemen,[2] icemen,[3] and others that are exposed to vicissitudes of weather or to alternations of extreme cold and extreme heat, or that pass a considerable portion of the day in a hot or steam-laden atmosphere, are notoriously prone to contract consumption. It is certainly the part of wisdom for one constitutionally predisposed to tuberculosis to avoid the dangers incident to such vocations, while it is a reproach to our civilization that industry should be the death of any.

It could once be truthfully said:[4] "If we raise our view from the lower to the higher classes, we shall here perceive that it is upon the lilies of the land, that neither toil nor spin, that the blight of consumption principally falls. . . . . You will find them all just like so many divinities of Epicurus—not indeed basking upon clouds in the mild empyreal warmth of heaven, but fixed almost as immovably upon well-cushioned chairs and sofas in hot, close apartments." Fortunately, this extreme indolence of women of fashion is no longer to be found save in a few instances; but the warning conveyed is none the less to be heeded.

Oxygen.—In the discussion of food-stuffs we incidentally referred to oxygen as being properly included among their number. Objection may be made that its association with the hæmoglobin of blood-cells is only temporary, while its combination with the constituents of other tissue-cells is not part of the process of constructive metamorphosis, but of that of destructive metamorphosis, the products of such combination being of the nature of excretions. Even admitting

[1] Not less than six out of seven are said to die consumptive in their apprenticeship (Carlisle, cited by Beddoes).

[2] See paper by Thos. J. Mays, *Med. and Surg. Reporter*, Sept. 27, 1890.

[3] Personal observation.

[4] Beddoes, *op. cit.*

these facts—which, however, represent but a part of the truth—the broad view we have taken of the problem of nutrition as a manifestation of bionergy justifies the inclusion of this agent among foods, for the reason that no physiologic manifestation of energy in the human body is possible in its absence. It must be supplied to the cells that are concerned in the elaboration of the ingesta into assimilable products. It must be supplied to the cells that originate and transmit to the cells having digestive function that special form of energy which we know as nervous stimulus. It must be supplied wherever and whenever the organic life is to continue in an active condition, not only because oxidation is necessary to the production of circulating energy, but in order that materials that have been for a certain length of time incorporated in the tissues of the body may be consumed, their ashes carried away and returned to the inorganic kingdom, and their place supplied by new material capable of renewed function. Its proper supply is thus an indispensable factor in function and in nutrition; and although its action is apparently destructive, it is the chief of constructive agents.

To feed a hypotrophic subject therapeutically by way of the alimentary canal alone is impossible. Attention to "respiratory diet"[1] is equally necessary. When open-air life, exercise, and other measures already discussed fail to bring about that decided change in the patient's condition which is the object of treatment, and in consequence he fails to obtain the benefit of the meat and drink administered; or when circumstances have prevented us from carrying out the open-air treatment as fully as is desirable; or in cases in which local pathologic conditions in the lungs demand special measures for their correction,—we must have resort to additional therapeutic methods.

The inhalation of oxygen early suggested itself, and has had more or less enthusiastic advocacy from the time of Priestly to the present day. For my own part, while I recognize certain conditions, principally acute, in which it is of temporary benefit, and which will be set forth in another connection, I do believe that mistaken notions on the part of physicians and of patients as to the true place of oxygen in therapeutics have been the means of depriving many a consumptive of his chance for continued existence. Especially have advertising quacks in America, for the basest purposes of selfish gain, exploited oxygen and its mixture with nitrous oxide under various taking names, reaping for themselves a bountiful harvest of dollars, and for Death a bountiful harvest of lives. Newspaper proprietors and magazine publishers are not without responsibility in this matter, for the conscienceless scamps who prey upon the misery and the credulity of

[1] I use Sales-Giron's term here in but a slightly different sense from that which he gave it.

their fellows have been quick to perceive and to avail themselves of the reading habits of this great American people, and their deadly falsehoods are carried on the covers and in the most conspicuous columns of the best—and of the worst—journals and periodicals into the homes of the credulous rich and cultured, as into the tenements where the credulous poor and ignorant are herded. Physicians, as guardians of the public health, owe a duty to the community to denounce and expose this crime against the weak and helpless, and to arouse in the consciences of the accessories a just recognition of their part in the wrong. Nor should we longer shirk this plain duty because of the fear of the flippant reproach of "interested motives." Should we not be interested beyond measure in the rescue of the sick from their enemies, and in the purification of the profession of healing from the stain that camp-followers and mercenaries bring upon it? In God's name, then, let us, being without reproach, have no fear of the taunts of the thoughtless and of the sordid, but lend our best endeavors to save the community from parasites more deadly than the tubercle bacillus.

If the inhalation of undiluted oxygen, or of oxygen artificially diluted with nitrogen and its oxide, have only limited therapeutic application, yet the inhalation of oxygen as mingled with nitrogen by nature has decided and almost universal therapeutic efficiency, and the therapeutist must direct his attention to securing the proper performance of such inhalation. Taking for granted that the rules already laid down for renewal and purification of the air are carried out, there is in the atmosphere more than a sufficient quantity of oxygen to supply all needs; but the patient does not always avail himself of Nature's bounty. After having provided a pure atmosphere, the first duty of the physician is to secure a proper respiratory habit, a complete and perfect performance of the respiratory act. We have already seen that something may be done in this direction by regulated exercises and by the stimulating effect of cold water. In very many cases, however, these are not sufficient; especially in cases of poor thoracic development; in cases of actual loss by consolidation or otherwise of lung surface or substance; in cases of muscular weakness or debility; in cases where open-air life or climatic influences are not attainable to the extent desired. We have incidentally alluded to the effect of the rarefaction of the atmosphere obtained by residence in elevated regions. We have now to consider this subject more particularly, and also to take up for discussion the effect of artificial modification of the pressure, humidity, temperature, and chemic constitution of the respired air, as a substitute for climatic treatment, when change of residence is not practicable. As this latter division of our theme is not discussed elsewhere in this SYSTEM, I shall describe briefly, but somewhat more in detail

than would otherwise be necessary, methods of procedure and physiologic effect, in order that our therapeutic advice may have a secure basis.

Bennett (1654), Bartholin (1654), Beddoes (*circa* 1790), Laennec (1826), and J. Solis-Cohen (1867) are among those who have urged attempts to imitate at home desirable features of various climates.

Altitude.

There is one factor common to all elevated places—rarefaction of the atmosphere. The other climatic factors vary greatly at different mountain-resorts. In the observation of individual cases or in the study of clinical statistics of localities it is difficult to estimate just how much, and just what element, of the observed or reported results are due to the respective qualities of the climate; yet when prolonged study by many observers, of many cases, at different places, exhibits a number of common results, it is reasonable to attribute these to the influence of a common condition; in this case rarefaction of the atmosphere. To this alone our attention will now be confined.

Rarefaction of the atmosphere brings about not only diminution of the pressure upon the body, but also diminution of the weight of oxygen contained in a given volume of air. Each of these factors is to be credited with a share in the result.

In considering the action of diminution of pressure it must be remembered that the pressure upon all portions of the body, including the lungs, is equally diminished, and that therefore none of the effects produced by certain forms of apparatus, and due to *difference* between pressure upon the lungs and pressure upon the external superficies, is brought about. This obvious fact needs mention because of a theoretic fear sometimes expressed of the production of hæmoptysis by increased tendency of blood to the pulmonary parenchyma, as in the inspiration of rarefied air from pneumatic machines. At altitudes within the therapeutic range the testimony of the best observers (Smith, Weber, Williams, Jaccoud, Dennison, F. I. Knight[1]) shows that in suitable cases there is no greater danger of hæmorrhage from the lungs than there is elsewhere; while indeed in some cases it is checked.

Jaccoud[2] remarks that hæmoptysis in itself furnishes no indication either for or against treatment by altitude, other collateral circumstances being more important. He lays greatest stress upon the "torpid" or "active" constitution of the patient, those of the first class being benefited by altitude in respect to hæmoptysis as to all other morbid phenomena, those of the latter class being injured.

[1] "Indications and Contraindications for Altitude in the Treatment of Pulmonary Tuberculosis," *Med. News*, Philada., Nov. 24, 1888.

[2] *Op. cit.*, p. 308.

Archibald Smith's[1] extensive experience in Peru not only confirmed him in the belief that altitude *per se* is the great remedy for phthisis, as likewise the cause of immunity in mountaineers, but afforded the observation that whereas hæmoptysis was common at the sea-level, and frequently the beginning of phthisis, it ceased and recovery took place at elevations of from 5000 feet to 10,000 feet. On the other hand, natives of the mountains, and many who had apparently recovered by removal thither, became hæmoptoeic on descending to the coast.

Curtin[2] argues that *rarefied air* tends to prevent hæmorrhage by arresting ulcerative processes and by lowering arterial tension, and that these factors overbalance the unfavorable tendency of increased heart-action and loss of support to the lungs. *Cold air* contracts the tissues and blood-vessels, while *dry air* robs the diseased structure of its moisture, decreases the fluidity of the blood, and blocks up the blood-vessels. At altitudes these conditions are usually associated, and, moreover, are combined with an *aseptic* condition of the atmosphere that favors the repair of lesions and hinders the action of the disease-germ; while *sunshine* and *outdoor life* add to the general improvement of nutrition. Hence he concludes that, in the absence of special counter-indication in the individual case, residence "on a high mountain (say from 5000 to 10,000 feet), far removed from the seacoast, is best for a patient with a tendency to hæmoptysis."

Dennison's[3] experience in Colorado has justified the expression "that there is no cause for fear" (of pneumonia or of hæmorrhage) "if proper precautions are taken as to extreme elevations and the character and stage of the disease existing in the lungs. There should be no spots of softened lung-tissue (especially near the root of the lungs) that are insufficiently protected by deposition of fibrous tissue. Only those cases should be sent who can bear the expansion and augmented circulation without rupture of blood-vessels. In portions of lung where there is no softening this increased pressure acts upon the distended vessels as does a properly-adjusted bandage to a swollen limb."

"The records of 202 consumptives .... in Colorado .... showed that the pneumonic cases and the hæmorrhagic (without cavity) were by far the best influenced of all varieties." "*Active* pneumonia or existing hæmoptysis" is a counter-indication. "If the pneumonia or hæmorrhage is recent, the contraindication amounts to little; if remote, to nothing. If there is reason for some doubt in any otherwise favorable case, a gradual rise in elevation should be chosen."

[1] *Edinb. Med. and Surgical Journal*, vol. liv., 1840, p. 1, *et seq.*; *Brit. and For. Med.-Chir. Review*, Oct., 1856, p. 479, *et seq.*

[2] "The Climatology of Hæmoptysis, etc.," *Trans. Amer. Climatological Assoc.*, 1889, p. 111, *seq.*

[3] *Op. cit.*, pp. 9, 10, 14.

At a less elevation than about 3000 feet the effects of rarefaction are inconsiderable. At a greater altitude than about 8000 feet, at least in Europe or North America, the effects are as a rule unpleasant, if not injurious. In the Andes, however, some of the best therapeutic results have been reported from elevations of 10,000 feet and more. From about 4000 to 6000 feet (giving a diminution of from about two and a half to three and a half pounds atmospheric pressure)—the elevation of Davos and the Upper Engadine in Switzerland and of many resorts in Colorado and New Mexico—seems to be the preferable range of altitude in the majority of cases; provided always that no indication against it is offered by the state of the nervous system, the heart, or the vessels. When the preferable range is counter-indicated or unattainable, resort may be had to stations at an elevation of from 1500 to 3000 feet, in which case, however, the other features of climate, especially low or not too inequable temperature, become of greater relative importance, and the medical care to be found at sanatoria is of much consequence.[1]

Patients suffering from disease tolerably advanced had best break into easy stages the ascent to such elevations as the Colorado resorts or Davos; and according to Jaccoud it is even more necessary to break the descent when returning home.[2] When the object of resort to altitude is prophylactic rather than remedial, the ascent and descent may be undertaken with less caution.

Invalids must not imagine that they are qualified to care for themselves, and that the air alone will cure them. They must go under competent medical advice, so that every detail of clothing, food, rest, exercise—in short, of daily life—shall be adjusted to place and time, to internal and external conditions.

The first effects of the rarefaction encountered at the greater eleva-

[1] Details do not belong to me to discuss, but by way of illustration it may be said that among the best of these moderate-altitude stations are—in Europe, Görbersdorf in Silesia, the site of Brehmer's Institute, and Falkenstein near Frankfort-A.-M., where Dettweiler's sanatorium is located; and in America the Adirondack region, in which the sanitarium under Dr. Trudeau's care has done such good work; Asheville, North Carolina; and certain points in the Blue Ridge and Alleghany ranges, where sanatoria are or ought to be established. It has seemed to me that the region between Stroudsburg and Mount Pocono in Pennsylvania offers some eligible sites for sanatoria which would have the prime advantage of easy access to the great cities of the East, thus ensuring many comforts to the patients which in less-accessible regions are difficult to obtain—not the least being an abundant supply of fresh meat. Mountain-cattle are few and give notoriously poor beef. Proximity to great markets is thus quite an important factor.

[2] It may be here interpolated that to return to former places of abode is injudicious for by far the greater number of those who, having advanced disease, do well in Colorado. At Davos it is found necessary to remain at least two winters to get the best results, though permanent abode there is not so easy a matter as it is in the midst of the vast area and varied activities of Colorado.

tions are marked disturbances of circulation and respiration. These gradually subside as the person becomes accustomed to his surroundings, leaving, however, certain permanent results, the attainment of which is the object of treatment. These effects may be briefly summarized as increased respiratory and circulatory capacity. While the immunity from phthisis found at altitudes by Archibald Smith[1] in the Peruvian Andes, Jourdanet in Mexico, Fuchs, Brehmer, Lombard, and others[2] in Germany and Switzerland, cannot be entirely due to the diminished atmospheric pressure,[3] but must be closely associated with purity of the air (using *purity* in its most comprehensive sense), yet the structural peculiarities of mountaineers and the changes in the shape of the thorax (and vascular capacity?) brought about in plain-dwellers by sojourn in the heights must be due to rarefaction almost exclusively. The additional *exercise* of the lungs necessitated by constant ascents is of course a material factor, but this would not be nearly so effective in a denser atmosphere.

There is an average normal arterial tension which is in relation with the atmospheric pressure usually experienced. When atmospheric pressure is diminished the niceties of adjustment are overthrown. The peripheral vessels, expanding, offer less resistance to the onflow of the blood, which accordingly accumulates at the superficies, the viscera being correspondingly depleted. There is venous as well as capillary turgescence, and the supply of blood to the right heart being diminished, while intrathoracic pressure is likewise lessened, the heart is compelled to beat quicker and more forcibly in order to restore the balance of the circulation. If it be competent, the effect is stimulating and invigorating, and leads ultimately to a moderate physiologic hypertrophy of heart and vessels, in which increase of capacity and augmented size and strength of wall are in balanced relation. Thus as adjustment is made to the new conditions the increased pulse-rate first brought about gradually diminishes; but the increased cardio-vascular tone and vigor persist.

The effect upon circulation cannot, however, be dissociated from the effect upon respiration; for the two have most intimate relations and their proper balance of function is essential to health. Respiration, too, has been adjusted to the ordinary barometric pressures. In rarer

[1] *Loc. cit.*

[2] Cited by C. Th. Williams, *Influence of Climate in Pulmonary Consumption*, London, 1877. Brehmer (*loc. cit.*) pointed out that in colder regions immunity was found at a proportionately less altitude. This influenced him to locate his sanatorium at Görbersdorf in Silesia.

[3] Valenzuela (*infra cit.*) attributes it to the diminution of oxygen; Alcock (*Lancet*, March 19, 1887), basing his arguments on the lowered boiling-point of water, attributes it to a hypothetical increased molecular motion of the blood, equivalent to a degree of temperature inimical to the life of the bacillus.

atmospheres the chest mechanically expands to a certain extent from relief of the weight upon it, but a still greater functional expansion is necessitated by the diminished supply of oxygen.[1]

At the sea-level 1 cubic foot of dry air at 32° F. contains 130.4 grains of oxygen, but at an elevation of 5000 feet the same quantity of dry air, at the same temperature, contains only 108.6 grains of oxygen. To compensate for the relative scarcity of oxygen a larger volume of air must therefore be inhaled at each inspiration. This increase in the volume of tidal air is brought about by augmented expansion due to increased muscular action; and the result is greatly to strengthen the respiratory muscles, to enlarge the thorax, and to produce a habit of full inspiration. Thus is caused ultimately fuller and freer expansion of the lung, especially in the apices and other little-used portions. The calling into full activity of regions of lung-tissue upon which little demand has been made under ordinary circumstances of sedentary and city life, is a benefit that cannot be over-estimated, whether we desire to secure full aëration as a prophylactic measure, or whether our object is to compensate by increased activity of remaining tissues for loss by consolidation or excavation. The delicate girl, the round-shouldered clerk, are compelled to hold head erect and shoulders back, and an almost incredible transformation in physique is wrought. The depth of inspiration is thus permanently enlarged. The frequency of respiration is at first very much increased, but as habituation occurs diminishes nearly or quite to the normal. In those subjects of actual disease who exhibit abnormal frequency of pulse and respiration notable diminution is brought about. In others, while vigor and capacity of both circulation and respiration are enhanced, there may be some slight persistent increase in rate or there may be a slight fall below normal frequency. In all cases it largely depends upon the sufficiency of the structural changes. Hence, as F. I. Knight points out,[2] patients of say fifty years of age, in whom the tissues are not flexible enough, should not be sent to altitudes. As to the verity of the structural changes, those who have not made personal observations and measurements may be fully satisfied by a glance at some of the tracings published by C. Theodore Williams.[3] (*Vide* Figs. 149 and 150.) That the pulmonary

[1] Weber (*Hygienic and Climatic Treatment of Chronic Pulmonary Phthisis*, London, 1888, p. 91) hesitates to accept this view, and still holds to the opinion he expressed in 1869—that the experiments of Tyndall and Frankland with burning candles at Mt. Blanc and Chamounix have demonstrated, as these authors claim, that the atoms of oxygen are more active, thus compensating for their lessened number.

[2] *Loc. cit.*

[3] *Trans. Internat. Med. Cong.*, London, 1881, vol. ii. p. 164, *seq.* Williams summarizes his observations as follows:

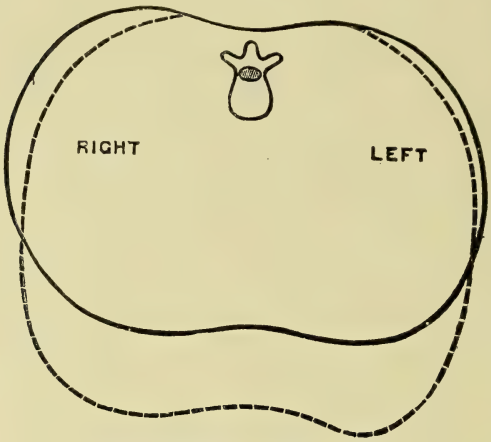
"1. That, as a rule, the portion of chest-wall overlying the healthy lung more frequently undergoes dilatation than that overlying the diseased lung.

expansion is a physiologic gain, and not a superinduced pathologic condition like ordinary emphysema, is demonstrated by the simple fact that expiration is perfectly performed.

Most noticeable in the chest of a patient just returned from a high-altitude station is its fulness. "There is no clear marking out of intercostal spaces, the supraclavicular hollows seem filled up, and there is often more apparent flattening in the region of the original lesion than when the patient started for the mountains. This is caused no doubt by the development of emphysema around the old lesion.

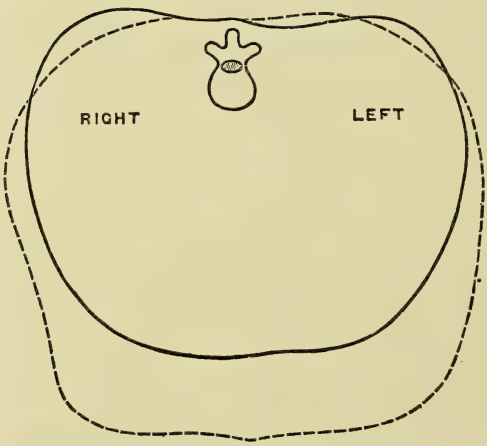
"*Percussion* as a rule gives hyper-resonance over nearly the whole chest, most on the healthy side; next over the healthy portions of the affected side, leading off into resonance, and even into slight dulness, over the seat of the old lesion. The hyper-resonance which most attracts our notice is that given by the interscapular, suprascapular, and scapular regions, perhaps because we least expect to

FIG. 149.



Before Residence at Davos ——.
After Residence at Davos — — —.

FIG. 150.



Before Residence at Davos ——.
After Residence at Davos — — —.

Tracings illustrating Thoracic Expansion at Altitudes (Williams).

"2. That the dilatation may be in either an antero-posterior or lateral direction, or sometimes in both. The first mentioned is most common.

"3. That the dilatation is more common in the upper regions of the chest than in the lower. The largest dilatation takes place at the level of the third rib in front, the smallest about the level of the ensiform cartilage.

"4. That if the disease be limited to the apex of one lung, there may be flattening of the chest-wall immediately over the lesion, and extensive dilatation of the lower or lateral portions of that side, giving rise to remarkable deformities of the thorax.

"5. That the length of residence required to produce this thoracic expansion varies in different cases, but that, as a rule, some months are necessary, it being depend-

find it in these quarters; but in lungs free from disease, whose owner has resided for several months at high altitudes, taking abundant exercise, hyper-resonance is to be found in all regions of the chest. On *auscultation* we find on the healthy side that the respiration has become harsh and puerile, the inspiration long and deep, like the sounds of the unaffected side in a case of pleuritic effusion. On the diseased side the principal changes are that dry sounds take the place of moist ones, and, instead of coarse crepitation, tubular sound and dry crackle are audible, and especially prolonged expiration in the neighborhood of the old cavity or consolidation. Bronchial breathing and bronchophony are bound to generally diminish after a residence at high altitudes."

Williams also believes that dilatation of the alveoli in the neighborhood of the various lesions produces an important localizing effect, and thus tends to prevent the spread of tubercle by secondary infection from a caseous centre or from a secreting cavity with inflamed walls; while the emptying of the vessels and of the capillaries of the region through alveolar dilatation leads to the caseation and cretification of the tubercular masses.[1]

There is another possible factor in the total effect to which Creighton[2] has called special attention. According to Paul Bert, the oxygen-carrying capacity of hæmoglobin is diminished at altitudes, owing to the diminished tension of the gas, and as a consequence the quantity of hæmoglobin in the blood has to be increased in order that a due supply of oxygen for tissue-changes should be furnished. "The more complete the adaptation of the blood to the rarefied atmosphere," therefore, "the more permanently will the tubercular diathesis be held in check" by the enrichment thus secured.

Recalling the observations of Rokitansky, Brehmer, and Beneke, previously cited, we can now better appreciate the prophylactic power of altitude; for prophylaxis is still our principal theme. From the increased cardio-vascular capacity, even more than from the increased pulmonary capacity, but from both together more than from either singly, result increased hæmatosis, increased tissue-nutrition, increased gaseous exchange, increased function, and increased elimination of

ent on the respiration-rate and on the yielding or non-yielding nature of the thoracic wall. As a rule, thoracic expansion is most rapid in patients who take much exercise.

"6. That the duration of this expansion after a return to lower levels varies, but in the majority of patients is permanent. In one case considerable dilatation only lasted seven months, in another six months."

[1] Weber (*loc. cit.*) holds that the diminished capacity of the air at high altitudes for holding water in suspension must cause a withdrawal of both heat and moisture from the human body, and especially from the lungs, producing a cooling effect on the smaller bronchi extending into the alveoli, and that the drying influence may be the cause of the disappearance of moist sounds from the lungs, and may assist in the calcification of caseous masses.

[2] *Brit. Med. Journ.*, April 16, 1887, p. 822.

the waste products of function; with, too, an increased buoyancy of spirits, which is no mean factor in treatment; in a word, heightened vital energy. Katabolism and anabolism are reciprocally stimulated. The hypotrophic subject is permanently relieved of some of his disabilities, and his entire organism is strengthened for the coming struggle against disease. Similarly, the patient in whom actual pulmonary disease is present is reinvigorated, and a portion of the loss of tissue and function is compensated.

As, however, pyrexial tendencies are increased in common with katabolic processes in general, continuous high temperature is a counter-indication to treatment by altitude. Intermittent fever is not a counter-indication, unless the paroxysm be manifested by very high temperature and the patient be one of those "erethetic" subjects designated by Jaccoud as of "active reaction."

Artificial Pneumotherapy.

Sojourn at an altitude is preferable, when possible, to the institution of those pneumotherapeutic measures which must be carried out by means of apparatus. For one thing, it is unintermitted. By day and by night, indoors and out of doors, the beneficial influence is quietly at work, independently of the patient's will, almost without his knowledge. For another thing, it combines with the benefits of rarefaction those of pure air, out-of-door life, and, if the resort be well chosen, of low temperature, dryness, and other desirable climatic qualities. However, there are very many—the vast majority, in fact—for whom these natural advantages are unattainable, and some that might otherwise be able to go to mountain-resorts are too feeble to be sent from home. Attempts must therefore be made to provide substitutes by the resources of art.

We may for therapeutic purposes modify the air in respect to its density, its temperature, its humidity, and its chemic constitution.

First, let us consider

Modifications of Density.—These are of two kinds, compression and rarefaction. They may be made to affect both, and equally, the respired air and the surrounding atmosphere, or one of these factors only, or both unequally.

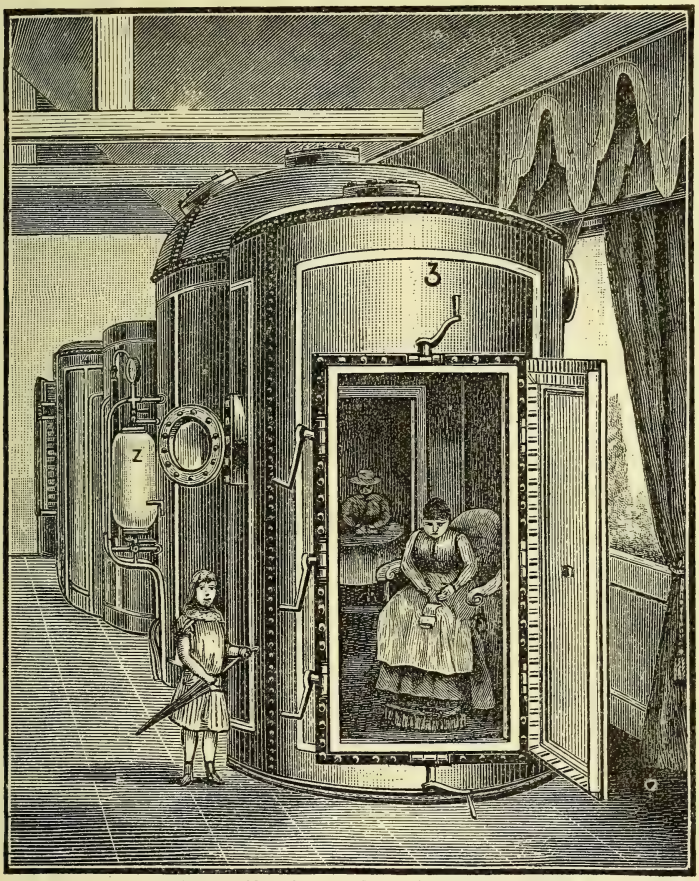
The earlier method, proposed by Tabarie in 1832 and carried into practice by him in 1838,[1] thus antedating the general recognition of treatment by altitude, immerses the patient in compressed or rarefied

[1] For bibliographic, descriptive, and historic details see J. Solis-Cohen, *Inhalation, etc.*, Philada., 1867; 2d. ed. 1876; Oertel, *Handbuch der Respiratorischen-Therapie*, Leipzig, 1882, illustrated. For the most thorough and scientific exposition see Waldenburg, *Die Pneumatische Behandlung der Respirations- und Circulations-Krankheiten*, Berl. 1875. For full summary of the subject see my paper on "Pneumatotherapy," *Therap. Gaz.*, Jan., 1887.

air, which he likewise inhales. The later, and I think better, method, for which the first practicable apparatus was made by Hauke in 1870, has been happily termed by H. F. Williams[1] of Brooklyn "pneumatic differentiation," for the patient inhales air *differentiated* in density from the atmosphere surrounding him.

The method of Tabarie is carried out in air-tight "pneumatic chambers," constructed of stone or metal, or both, the first chamber

FIG. 151.



Pneumatic Chambers at Brussels (after Hovent).

having been modelled after the diving-bell. They are to be found at various resorts in continental Europe, and one has recently been intro-

[1] The "pneumatic cabinet" of this observer (*N. Y. Med. Record*, Jan. 17, 1885) consists of a small air-tight cabinet into which the patient enters, and from which, while surrounded by air slightly rarefied ($-\frac{1}{30}$ atmosphere or thereabouts), he inhales the air of the apartment. I do not rate this method as high as that in which the patient respires altered air. The machinery is far more costly and is not applicable to home treatment.

duced by C. T. Williams into the Brompton Hospital in London. I know of none in America. A very well-equipped establishment at Brussels is under the care of M. Hovent, through whose courtesy I was able to witness and to experience in my own person the effects of the compressed-air bath.

At the pneumotherapeutic institution of Brussels[1] (Fig. 151) there are several iron chambers of different sizes, so constructed that the occupants are always under observation by means of glass windows, and having a number of ingenious appliances by means of which access to the patient may be had, communication may be held, and articles passed in and out, without much disturbance of the pressure. One or more patients having entered the chamber, wherein are electric bell, electric lamps, comfortable chairs, tables, reading and writing materials, toys for children, and the like, the contained air is gradually rarefied or condensed by means of a pump worked by a gas-engine. Special appliances secure proper renewal of purified air and permit regulation of pressure, humidity, temperature, etc. There are attachments for the use of oxygen, nitrous oxide, or other gases, and of medicinal sprays and vapors, when required. After a sitting of from half an hour to two hours the pressure is gradually restored to the normal, and the patient is allowed to emerge. Hovent, as a rule, takes half an hour to reach the maximum pressure employed, maintains it for half an hour, and consumes a third half hour in the restoration to the norm. All dangers from sudden change are thus avoided.

In the *compressed-air bath* excess pressures of from one-fifth to one-half of an atmosphere (3 to 7.5 pounds) are employed. The effects are due to the increased pressure upon the interior of the thorax and upon the periphery, as well as to the physical modifications of the air brought about by condensation, and its relative richness in oxygen.

Inspiration becomes easier, expiration being slower and more laborious. As a consequence, the respirations are reduced in frequency and increased in depth, and the mobility of the thorax is increased. These effects continuing after the return to ordinary conditions, the ultimate effect is a gain in vital capacity. The dilatation of the heart is antagonized, but to a less degree than its contractions are aided; for the normal amount of inspiratory negative differentiation can be brought about by increased muscular effort. Arterial blood-pressure is, upon the whole, lowered, so that the pulse becomes smaller and slower, and the blood tends from the superficies, both respiratory and general, to the deeper parts and to those vessels contained in cavities with rigid and firm walls. There is increased absorption of oxygen and increased tissue-change, therefore increased nutrition and increased excretion. Upon the nervous system the effects are sedative and soporific.

[1] *Vide* Hovent. *Trans. Philada. County Med. Soc.*, 1891.

Concerning pathologic conditions, it may be noted that hyperæmia is diminished and absorption of effusions and of inflammatory new-formations mechanically favored by compression.

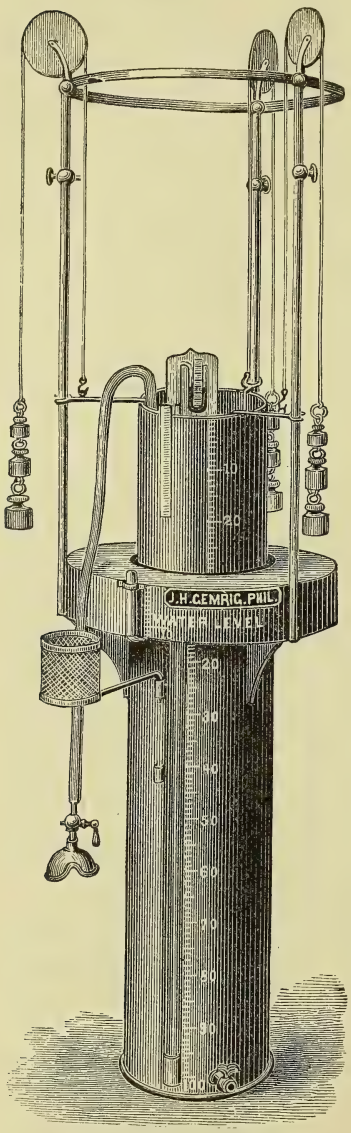
The expedient, therefore, is theoretically indicated in the same classes of cases as are benefited by residence at altitudes. In the absence of personal experience I can only repeat the recommendations of others, but the testimony of reliable observers goes to show that it is of signal advantage in the prevention of extensive lesions in predisposed subjects with manifestations of incipient phthisis; that it relieves chronic congestive and inflammatory conditions of the air-passages, acute and subacute bronchitis, which might lead to pulmonary catarrh, and eventually to phthisis; that it promotes the absorption of pleuritic effusions; and that it exerts a beneficial influence over all forms of pulmonary consumption. Counter-indications are held to be presented by great muscular weakness; by septic products in lungs or bronchi that might be absorbed; by high daily fever; by softening or excavation of lung-tissue sufficient to give rise to danger of rupture or of hæmorrhage; and by general tuberculosis. Hovent, however, does not find absolute counter-indications in fever or in hæmorrhagic tendencies, and I saw cases of his that had been benefited despite these symptoms. In all probability, the truth is that the same indications hold here as in treatment by altitude; and theoretic objections must fall before the experience that demonstrates the instability of their theoretic basis. Other counter-indications are states of the brain, spinal cord, or abdominal viscera, in which an increased supply of blood would be harmful.

The action of *rarefied air* in the pneumatic chambers is generally likened to the effects produced by ascent of mountains or in balloons, but certain differences exist, owing to variation of atmospheric conditions in the higher regions. Paradoxical as it may seem, compressed air, and not rarefied air, better imitates the therapeutic effects of altitude. In the absence of personal observation of the effects of the rarefied-air bath I am unable to estimate properly the few reports and largely theoretic recommendations of authors, and therefore abstain from any expression of opinion. I believe the method has its uses, but they have not been established.

The great drawbacks to treatment by means of the pneumatic chambers are the costliness of the apparatus, and its consequent restriction to certain resorts. I believe that in every place where there are a few score physicians—*a fortiori* in great cities—there should be at least one establishment with competent supervision where these and other apparatus requiring skilled attendance should, under suitable regulations, be at the service of the profession. The institution at Brussels might serve as a model, with such variations as different local conditions would require. Meanwhile, however, the principal resort

must be to cheap portable apparatus, which, moreover, it seems to me, offer certain *therapeutic* advantages over the pneumatic chambers.[1] They permit of inspiration from, and expiration into, air differing in density from the surrounding atmosphere, or, in other words,

Fig. 152.



Waldenburg's Gasometer.

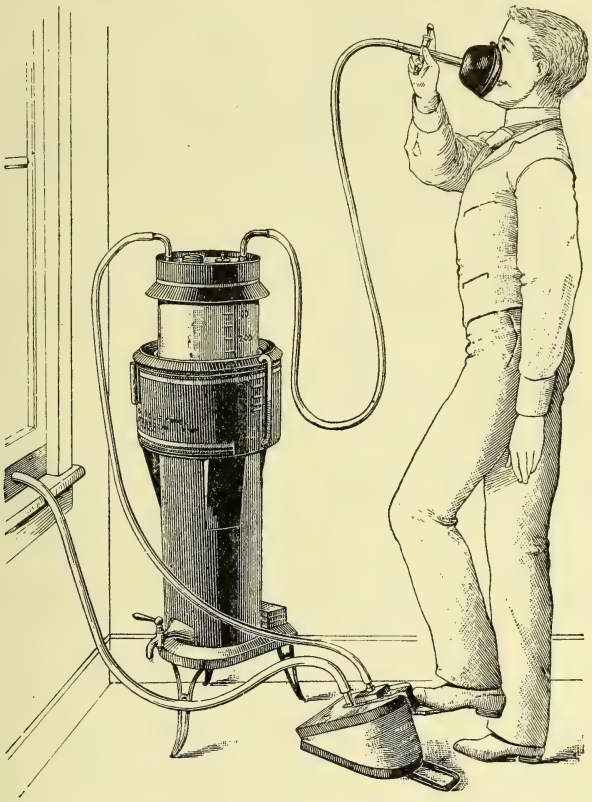
Pneumatic Differentiation.—Many different forms of apparatus[2] have been devised since Hauke in 1870 constructed the first machine for administering inhalations of compressed air. The best in many respects is that of Waldenburg (Fig. 152), the observer that has done most to place aërotherapy on a firm scientific basis. This machine, however, while admirably adapted for use in the physician's office, is not only somewhat expensive to import into America, but too large and cumbersome to be placed in the patient's chamber, and rather difficult for a weak patient to manage unaided. At the suggestion of J. Solis-Cohen, I made numerous experiments with the view of devising an apparatus that should be smaller, cheaper, simpler, and continuous in action; and might therefore be placed in the home of the patient. As much of the success of the various pneumotherapeutic measures depends upon their continuous and uninterrupted use, and as inclemency of weather and many other circumstances are bound to cause interruptions if it is necessary to visit the physician's office each time, the importance of the last desideratum is evident. Besides this, the time necessary for personal administration of the inhalations is too great to be well spared by a busy physician if he have many patients under this treatment.

[1] Hovent, who has used both forms of apparatus, whereas I have used only the one, does not agree with this opinion.

[2] Space to describe these is wanting. See J. Solis-Cohen and Oertel, *opera cit.;* H. Williams, *Trans. Amer. Climatological Ass'n*, 1885, p. 53.

In 1883, having become convinced, after fair trial of instruments of various mechanic principles, that a combination of the gasometer and bellows answered best, I constructed, with the assistance of Mr.

Fig. 153.



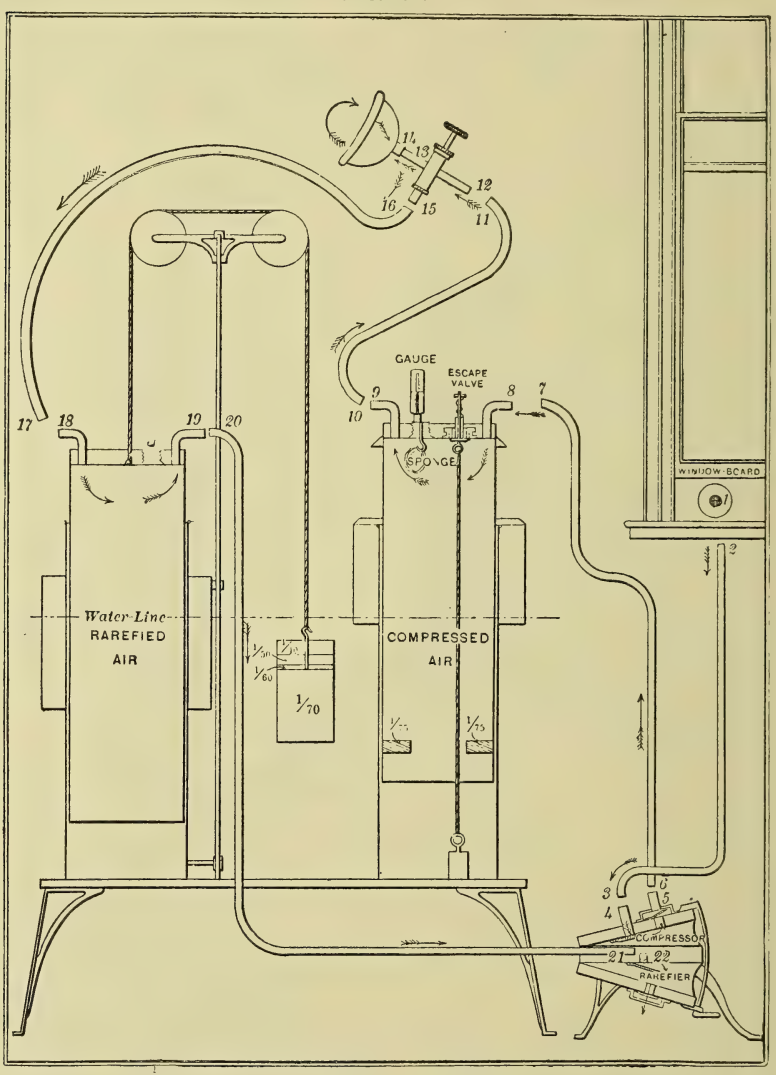
Author's Compressed-Air Apparatus.

Charles Richardson, a modification of Waldenburg's apparatus; the important features (Fig. 153) being a reduction in the size of the cylinders, and the use of a foot-bellows to keep up a constant supply of pure air.

Since first described in the *N. Y. Medical Journal* for Oct. 18, 1884, the apparatus has been greatly improved. As now constructed (Figs. 153 and 154), the air-chamber is eight inches in diameter and twenty-four inches high. The water-chamber is pierced at the level of the base of the overflow tank (seven inches from the top) with a row of perforations, allowing the water to escape into the tank under pressure of air in the air-cylinder. A glass tube connected with the tank shows the level of the water therein, and by means of a scale painted on the outer surface of the tank acts likewise as a gauge showing the

pressure. The air-cylinder carries, two inches from its open base, two shelves, one on each side, on which are placed ballast-weights for the purpose of lowering the centre of gravity and thus maintaining the

FIG. 154.



Sectional Diagram of Author's Apparatus for Pneumotherapy.

Explanation of figure: The parts are numbered in order of attachment and in the direction of the air-current; from the window to the mask through the compressed-air gasometer; and from the mask to the discharge-pipe of the rarefying bellows through the rarefied-air gasometer. The discharge-pipe may also be connected with the window if desired. The direction of air-current is indicated by the arrows. (In an apparatus now constructing the rod and pulley are done away with, and counterpoising effected from the two sides by an attachment to the water-tank.)

steadiness of the apparatus. Both shelves and weights are perforated to avoid undue resistance of water. As the area of the top

of the air-chamber is just fifty square inches, atmospheric pressure upon it equals, in round numbers, seven hundred and fifty pounds. With the ballast upon its shelves the cylinder weighs ten pounds, giving an excess pressure of $\frac{1}{75}$ atmosphere. Weights are furnished in two sizes in the shape of rectangular blocks of iron about $4\frac{1}{2}$ inches by 2 inches surface, and about $\frac{1}{2}$ inch thick and 1 inch thick, respectively. The smaller ones are bored out to weigh $1\frac{1}{4}$ pounds each; the larger ones to weigh $2\frac{1}{2}$ pounds each.

Being placed on top of the air-chamber in successive pairs (one on each side, to preserve balance), they bring the pressure up to any desired amount not exceeding $+\frac{1}{30}$ atmosphere. Thus:

Cylinder and bottom weights = 10 lbs. = $+\frac{1}{75}$ atmosphere.
$2\frac{1}{2}$ lbs. (two small weights) additional = $12\frac{1}{2}$ lbs. = $+\frac{1}{60}$ atmosphere.
$2\frac{1}{2}$ lbs. (two small weights) additional = 15 lbs. = $+\frac{1}{50}$ atmosphere.
$3\frac{3}{4}$ lbs. (one small weight and one large weight) additional = $18\frac{3}{4}$ lbs. = $+\frac{1}{40}$ atmosphere.
$6\frac{1}{4}$ lbs. (one small weight and two large weights) additional = 25 lbs. = $+\frac{1}{30}$ atmosphere.

The air-cylinder is furnished with two goose-necks (Fig. 154), one (*8*) for the attachment of the tube (*6*, *7*) from the bellows, conveying compressed air; the other (*9*) for attachment of the tube (*10*, *11*) connected with the stop-cock (*12*, *13*) and face-mask (*14*) or mouth-piece, through which the patient inhales. A perforation two inches in diameter is fitted with a screw-cap carrying a hook on which may be placed a sponge saturated with any volatile medicament (*e. g.* terebene) that may be desired. The cap likewise contains a smaller perforation, into which a manometer may be fitted. When the gauge is not in use this is closed with a rubber plug. Still another perforation in the top of the air-chamber is fitted with a valve that permits escape of air should too much be sent over from the bellows. This valve, which is superior to my own arrangement for the same purpose, is the ingenious device of Mr. F. Metzger of Philadelphia, who now makes the apparatus in every respect according to my instructions, and who has devoted much time and care to the details of construction in order to secure both strength and lightness. The escape-valve is composed of two flat plates of brass, the upper perforated, the lower unperforated. They are held in apposition by a spring, and when in apposition no air escapes. The lower plate carries a chain thirty-five inches long, to which is attached a weight that rests upon the floor of the water-chamber. Should too much air enter the cylinder, lifting it too high, the plates are pulled apart, the air escapes through the perforated plate, and the cylinder falls to the proper level. This obviates any liability to splashing of water, which before this attachment was made

would occur if attention were not paid to a line painted on the cylinder to indicate cessation of pumping. By means of the automatic escape-valve we are enabled to introduce a continuously acting pump if desired.

As an additional precaution against splashing, the air-chamber and overflow tank are each provided with a deflecting hood about an inch and a half wide and inclined at an angle of forty-five degrees.

The second gasometer is for expiration into rarefied air. The connection with the bellows is reversed, so that the latter takes air from the gasometer and delivers it into the room or the street; and the air-chamber is suspended from a small pulley and counterpoised with weights varied according to the desired negative pressure. The mechanical arrangement of pulleys and weights, the devices for adjusting the weights, the lowering of the outer water-tank (now a reservoir, and not for overflow), etc., are so obvious and so easily understood by looking at the figure ("Rarefied air," Fig. 154) that description in detail is unnecessary. Mr. Metzger has used a wire rope in preference to one of hemp. The combination of the two gasometers into one instrument is effected by means of a bellows which at the same stroke compresses air for delivery into one cylinder and rarefies air in order to exhaust the other cylinder. It is in reality two bellows, mounted back to back on the same frame. The downward stroke of the lever compresses the upper bellows and expands the lower one. The recoil of the spring in the upper bellows expands that one and compresses the other. There is no communication between the two bellows. By means of a tube (*2*, *3*) passing out of a window-board (*1*), the external opening being protected with wire gauze, the supply of air for inhalation is drawn from out of doors.

When both instruments are used together, being brought into communication through the lungs of a patient by means of a double stop-cock connected with the face-mask or mouth-piece, the route for the air is as follows:

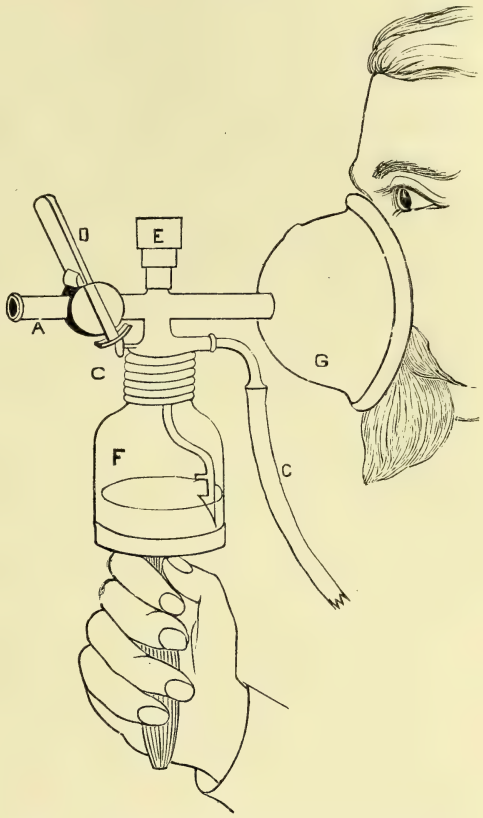
(*a*) From the street, (*b*) through the upper bellows, (*c*) to the compression gasometer, (*d*) thence to the lungs; (*e*) from the lungs (*f*) through the rarefaction gasometer (*g*) to the lower bellows (*h*), which expels it into the room or into the street.

The compression and rarefaction are virtually made in the respective bellows. The gasometers act to a certain extent as reservoirs, but chiefly as intermediate regulating chambers, rising and falling to maintain a constant pressure in exact accordance with the weight placed upon them, and independent of the volume of air inhaled or exhaled. Their available capacity is a little more than eight hundred cubic inches.

For purposes of observation, sufficiently accurate for clinical com-

parisons, though not for physiologic data, the air-chambers carry a scale of cubic inches, enabling us to see the approximate volume of air inhaled or exhaled at each respiration. Apparatus for warming, chilling, drying, moistening, or medicating the air to be inhaled may be interposed at any desired point between the window and the patient. The most convenient method of medicating the air is by means of the sponge, as described. A variety of other methods are applicable. Thus a volatile medicament may be placed in or on the water contained in a Wolff bottle, through which the air is passed; or the spray from Oliver's vaporizer may be thrown into the inspiratory current by some such device as that represented in Fig. 155.

FIG. 155.



Author's Apparatus for Medication of Compressed Air by Spray from Oliver's Nebulizer.

F, Nebulizer containing medicinal solution; E, expiration valve; D, lever admitting air and turning on spray; A, attachment for compressed air (low pressure); C, attachment for compressed air (high pressure for spray); G, face-mask.

In using the apparatus the patient should preferably stand, but he may sit if necessary. If a face-mask be used, it should be accurately adjusted over the nose and mouth and made to lie close to the cheeks to prevent escape of air. In many cases, a glass mouth-piece may be used instead of a face-mask; and it is unnecessary to close the nostrils, as nose and mouth cannot be conveniently employed together for forced respiration, and there will be no interference. Each patient should have his own mask or mouth-piece.

To govern the ingress or egress of air to or from the face-mask or mouth-piece, I use either Waldenburg's two-way stopcock or one modelled on the cornet-piston. The latter consists of a central barrel, carrying a hollow cylinder, controlled by a spring, and a horizontal tube, communicating freely with the central barrel. The face-mask or mouth-

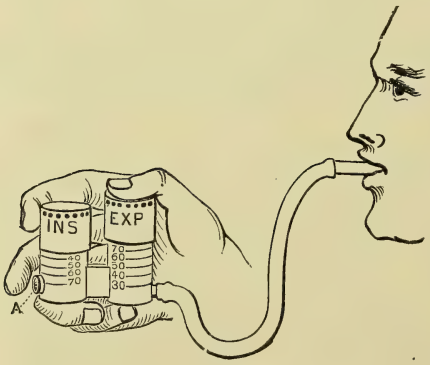
piece (*14*, Fig. 154) is connected with the proximal extremity (*13*) of the horizontal tube; the delivery-tube of the compression gasometer (*10*, *11*) with the distal extremity (*12*). The inner central cylinder contains two, or rather three, perforations. Two of these are opposite to each other, and when brought in line with the horizontal tube form with it a continuous channel. In this position air is allowed to pass from the compression apparatus through the mouth-piece or face-mask to the air-passages of the patient. The other perforation has no opposite fellow, and is on the side facing the mask or mouth-piece, so that when it is brought opposite the horizontal tube the air enters from the patient's lungs and escapes through the inferior opening (*15*) in the central barrel. If it is desired to have exhalation made into rarefied air, this inferior extremity of the central barrel is connected (*16*, *17*, *18*) with the rarefaction gasometer. If the rarefaction apparatus only is to be used, the attachments to the compression gasometer are of course omitted.

If it is desired to have the patient exhale into compressed air, instead of connecting the stopcock with the rarefaction gasometer, we can insert into this lower opening (*15*) an expiration-resistance valve, as made for me by Messrs. Codman & Shurtleff of Boston, and first described in the *New York Medical Journal* for December 3, 1887.

If it is desired to have him inhale rarefied air, instead of connecting the stopcock with the compressed-air apparatus we insert into the horizontal tube (*12*) an inspiration-resistance valve.

The "resistance valves"—which I have called by that name because they offer a resistance to the passage of air—are simply little cylinders containing ebonite valves controlled by spiral springs. The tension of the spring is regulated by turning the cap of the cylinder, and a scale engraved upon the side gives its value in fractions of an atmosphere. The *expiration valve* is arranged to move *toward* the perforated distal end of the cylinder, thus allowing the expiration current to escape whenever the pressure of the expired air reaches the indicated figure. The valve of the *inspiration* cylinder is arranged to move *from* the perforated top of the cylinder, thus allow-

Fig. 156.



Author's "Resistance Valves."

A, Aperture permitting air to pass beneath valves unless occluded with finger or plug.

ing the inspiration current to pass toward the patient whenever the rarefaction within the lung reaches the indicated figure. The two valves, suitably mounted in one instrument, may be used independently of the gasometers (Fig. 156). They oppose, by a known pressure, both or either of the phases of respiration. The exact regulation of pressure is their peculiarity and chief merit. They are simply a better instrument than the tube (five feet long and one-half inch in diameter with narrowed extremities) used by Ramadge,[1] and effect the same purpose that this pioneer in aërotherapy aimed at:—namely, hyperdistension of the pulmonary alveoli through (*a*) increased muscular respiratory effort; (*b*) prolongation of the time of both phases of respiration; and (*c*) backward pressure of contained air during expiration. Their greatest usefulness in this way is as a means of regulated pulmonary gymnastics, either to keep up the good effects of treatment with the gasometer methods, or in prophylaxis before resort to the gasometers has become necessary.

With the two gasometers described, the double bellows, and a pair of resistance valves we are able to obtain the mechanical satisfaction of all the conditions required for any of the following therapeutic expedients:

	Inhalation of	*with*	*Exhalation into*
1.	Compressed air	. . . . .	Atmosphere.
2.	"	. . . . .	Rarefied air.
3.	"	. . . . .	Compressed air.
4.	Rarefied air	. . . . .	Atmosphere.
5.	"	. . . . .	Rarefied air.
6.	"	. . . . .	Compressed air.
7.	Atmosphere	. . . . .	Rarefied air.
8.	"	. . . . .	Compressed air.

If a pump and motor are substituted for the foot-bellows, the only inconvenience connected with office use of the apparatus can be obviated. The additional cost is not excessive, and it leaves the apparatus still well within the price of any other capable of doing the same work.

My endeavor has been throughout to use the simplest and least expensive methods and mechanic devices, and I have tried to induce the manufacturers to reduce their prices to the lowest point in order to secure the widest possible and freest possible diffusion of the method, which I look upon as one of the most useful within the reach of the therapeutist.

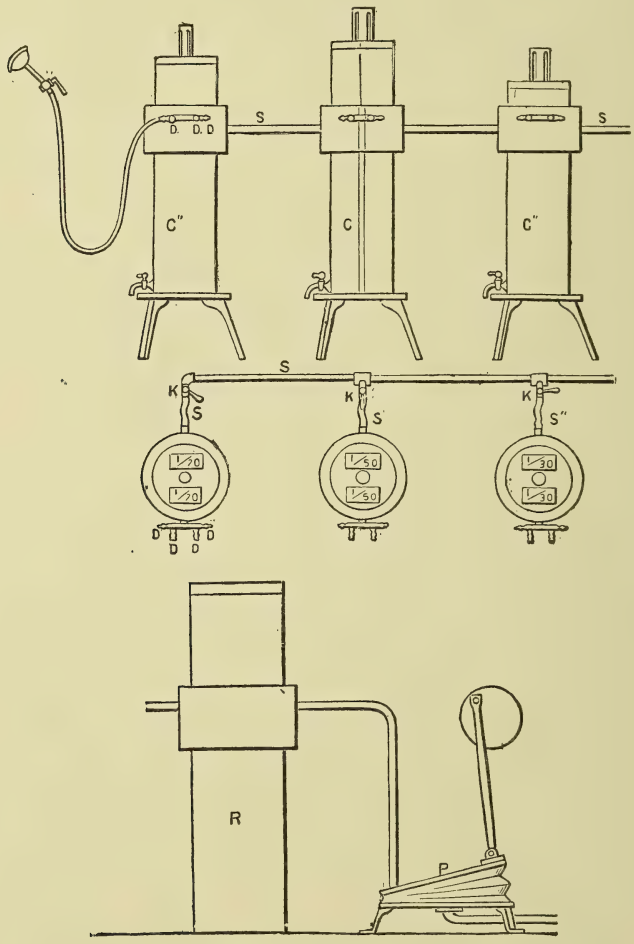
For the proper utilization, according to the differential method, of the therapeutic properties of condensed and rarefied air in hospitals or institutions where a large number of patients are to be treated, it is desirable that there should be constructed at moderate cost an apparatus with which several patients may be treated at one time, but that will

[1] *Consumption Curable*, London, 1834; New York, 1839.

nevertheless permit of accurate adjustment of pressure to the varying necessities of different individuals.

The following sketch is for an apparatus for compressed air to treat twelve patients at once (Fig. 157). As each patient inhales for but ten to fifteen minutes, and then rests for the same period before inhaling for the second time, seventy-two patients could be treated during two hours with this size of apparatus; so that it would be quite large enough for most institutions. It would be used, say, for fifty or sixty patients

FIG. 157.



Author's Pneumatic Apparatus for Hospitals.

about three to four hours daily, as most patients would require two sets of inhalations—one in the morning and one in the afternoon. It could thus be run, say, from 9 to 11 A. M. and from 3 to 5 P. M.

C, C′, C″, are gasometers slightly modified from Waldenburg's—

such, indeed, as employed in the home apparatus just described—except that, instead of being fitted with but one delivery-tube, each has four delivery-tubes, D, D, D, D, and the size of the cylinder is correspondingly increased. C is weighted at the bottom for a pressure of $+\frac{1}{80}$ of an atmosphere, and additional weights may be placed on top to bring the pressure up to $+\frac{1}{70}$ of an atmosphere. C′ is weighted for $+\frac{1}{60}$ atmosphere, and the pressure may be increased to $+\frac{1}{50}$ atmosphere. C″ is weighted to $+\frac{1}{40}$ atmosphere, and the pressure may be increased to $+\frac{1}{30}$ atmosphere. S is a supply-tube with branches, S′, S″, S, leading to a reservoir, R, into which air is pumped from the outside atmosphere (pure air) by a pump or bellows run by an electric motor or any other source of power. The power required will be between one-quarter and one-half horse-power. This reservoir is weighted to give an air-pressure greater than any used in the cylinders, C, C′, C″, and will always force air into them.

The reservoir can be so adjusted that when full it will automatically stop the pump or bellows, either by opening a switch if an electro-motor be used or by interrupting the mechanical connection if the source of power be a steam-engine or other motor.

Valves in each of the cylinders, C, C′, C″, controlling the connection between R and the gasometers, are so arranged as to automatically regulate the ingress of compressed air into the latter; so that when the air-cylinders have fallen to the lowest point the valves are open to their full extent, and, as the cylinders rise and reach the proper point, the valves are closed and the air-supply cut off. When a gasometer is not in use the air-supply is cut off by the stopcock K.

If necessary, apparatus for warming, cooling, drying, or moistening the air may be interposed at any desired point between the outer atmosphere and the patient. The gasometers have hook and sponge attachment for volatile medicaments, or special medication for the individual patient may be secured by interposing any appropriate medicating apparatus between the gasometer and the mask covering the face of the patient.

As many gasometers as may be desired may be brought into communication with the reservoir, and, if necessary, any increased number of delivery-tubes for patients may be connected with each gasometer. The gasometers may be arranged for any fixed or adjustable pressure desired. Of course all the patients using the same gasometer at the same time will inhale air at the same pressure. It is believed that the arrangement of pressures here suggested will meet ordinary requirements among the number of patients for which the apparatus is calculated. Patients beginning treatment would require from $+\frac{1}{80}$ to $+\frac{1}{70}$; those who had become accustomed to it would need from $+\frac{1}{60}$ to $+\frac{1}{40}$; exceptional cases would be benefited by $+\frac{1}{30}$.

Should a fourth cylinder be introduced, it might be permanently weighted for $+\frac{1}{60}$ and furnished with additional weights up to $+\frac{1}{30}$. Of course, if a cylinder is permanently weighted for any pressure whatever, that pressure may be increased to any amount desired, or, as in the ordinary apparatus for home and office use, each cylinder may be permanently weighted to $+\frac{1}{75}$ only, and furnished with weights up to $+\frac{1}{30}$. The sketch merely gives a general plan, capable of modification as required.

To supply three gasometers in constant use by twelve patients, estimating that the patients average ten respirations each per minute, and inhale on the average 200 cubic inches of air each at each inspiration—*i. e.* that from the three gasometers 24,000 cubic inches of air are delivered a minute, at an average excess pressure of $\frac{1}{60}$ of an atmosphere, equal to 24,400 cubic inches at ordinary pressure—the reservoir, R, would not have to be larger than about 12 inches in diameter and 36 inches in height. Any form of bellows or pump can be used that will give sufficient air.

If desired, apparatus for expiration into rarefied air may be combined with this. As it is not right to exhale into the same cylinder from which inhalation is made, separate gasometers, counterpoised, should be provided for the purpose, and connected with a large reservoir or a reservoir and pump. The pump would be supplied from the reservoir and discharge into the outer air.

Physiologic Effects.—*The differential method* of pneumotherapy is that most readily available, most manageable, and, on the whole, most beneficial. By the possibility it offers of facilitating or impeding the performance of both or either of the phases of respiration, together or alternately, it is particularly applicable in the case of patients too weak to respire properly unaided; or in whom pathologic conditions oppose one or the other, or both, of the phases of respiration; or in whom the normal respiratory rhythm has become perverted, whether from excess in one direction or from deficiency in the other. It also produces circulatory effects, due to the difference between intrathoracic and extrathoracic pressure; that is, between the pressure upon the heart, pulmonic vessels, and intrathoracic systemic veins and arteries on the one hand, and that upon the peripheral vessels on the other hand.

Atmospheric pressure upon the surface of the body remaining unchanged, increase of pressure upon the pulmonary surface may be obtained—1. By inspiration of compressed air. 2. By expiration into compressed air. Decrease of pressure upon the pulmonary surface may be obtained—1. By inspiration of rarefied air. 2. By expiration into rarefied air.

These procedures may be so combined as to maintain the increase or decrease during both phases of the respiratory act, or to allow of increase during one phase and decrease during the other. All of these combinations were recognized and described by Waldenburg.

Increased pressure facilitates inspiration and impedes expiration. Decreased pressure facilitates expiration and impedes inspiration.

The facilitation of inspiration or of expiration, or of both, is usually the object of treatment; hence *inspiration of compressed air, expiration into rarefied air*, and the combination of these procedures, are the methods most widely employed in cases of actual pulmonary lesion. *Inspiration of compressed air with expiration into the same medium*—which is virtually the method of the Brooklyn pneumatic cabinet—is highly recommended by recent American observers. *Inspiration of rarefied air*, and *expiration against compressed air*, singly or in combination, are the prophylactic exercises afforded by the tube of Ramadge and by my "resistance valves."

In treatment by pneumatic differentiation the amount of excess or diminished pressure employed is small—from $\frac{1}{80}$ to $\frac{1}{30}$ of an atmosphere; much less, therefore, than in the absolute method. In every case the smallest pressure is employed at first, and gradual increase is made according to the effects observed. The time varies from ten minutes to half an hour or longer, with interruptions. A period of rest should precede, and another follow, each period of treatment. The process is best repeated two or three times a day. For this reason, as well as to avoid interruption of treatment by inclement weather or from other cause, it is advisable to have each patient procure by purchase or rental an apparatus for use at home.

Inspiration of Compressed Air.—The excess pressure employed varies from $\frac{1}{80}$ to $\frac{1}{30}$ of an atmosphere (+ 9.5 to + 25 mm. of mercury). Inspiration should be as deep and prolonged, expiration as slow and gradual, as possible. From fifteen to fifty or even one hundred respirations, occupying from five to twenty minutes, may be made continuously, and the process repeated after a rest of five or ten minutes. The patient, if able, should stand, with head erect and shoulders thrown well back. When necessary, the physician may aid inspiration by pressing the shoulders backward or assist expiration by compressing the chest. When it is desired to localize or locally increase the effect, the healthy side of the chest (*e. g.*) may be strapped, or its motion diminished by manual pressure or pressure against a wall, chair-back, or other suitable object. Schreiber[1] has designed for this purpose a special instrument consisting of padded metal plates front and back, connected over

[1] *Zeitschr. für klin. Med.*, vol. xiii., 1887, p. 292, illustrated. I had a somewhat similar appliance made a short time before Schreiber's communication appeared, but I have never described it.

the shoulder by a metallic brace, with a screw to regulate the amount of compression.

The effects produced by inspiration of compressed air are, in brief:—decrease of muscular exertion necessary for inspiration; dilatation of the alveoli beyond that attainable by voluntary effort; increase in the quantity and in the penetrating power of inspired air, therefore reopening of air-cells disused from weakness, occluded by the products of secretion and desquamation, or agglutinated from similar causes; and increase in the volume and weight per volume of oxygen brought to and absorbed by the blood, a greater area of blood-surface being reached. The subsequent expiration is sometimes slightly retarded, but is deeper, the quantity of air exhaled and of carbon dioxide eliminated being increased. Tidal and complemental air are thus increased, reserve air diminished; the first two quantities and a portion of the third quantity being added to form what is now virtually an increased volume of tidal air, reaching two hundred cubic inches or even more. Diminished frequency of respiration, increased expansion, ventilation, and gaseous exchange, are therefore the immediate effects; increased vital capacity the ultimate and permanent result. The circulatory effects are those of heightened pressure—namely, an augmented centrifugal tendency of the blood-current; increased force of the ventricular systole; quickening or, later, increase in volume of the pulmonic circulation, bringing more blood, therefore more corpuscles, more hæmoglobin, in proportion to area, into contact with the increased quantity of oxygen; filling of the systemic vessels, with rise of arterial blood-pressure, the pulse becoming at first more rapid, afterward slower, full, and hard. The blood circulates more actively throughout the body, penetrating further into capillaries and lymph-spaces, and being richer not only in oxygen, but also in nutritive materials; for pressure upon the diaphragm, transmitted to the abdominal viscera, stimulates absorption of chyle, while heightened pressure and augmented volume of blood in the viscera tend to stimulate functional activity. The increased penetration of blood and increased activity of its current not only distribute more thoroughly the materials for tissue-building and force-production, but likewise remove more thoroughly the waste products of metabolism. Thus, increased oxidation and tissue-change stimulate appetite and improve nutrition; the increased quantities of food given are utilized, and there is more perfect combustion and elimination. Passing to the effects upon pathologic conditions:—pulmonary hyperæmia is relieved; inflammatory products are absorbed; cough and expectoration are at first increased from dislodgment of accumulated materials, afterward diminished from relief to irritation and diminution of pathologic secretions. Expansion of the chest over areas of condensation and of pleuritic adhesion

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is demonstrable, being due partially to the effect upon the diseased portions of the lung, but more largely to compensatory dilatation of neighboring healthy portions, which is not properly to be termed emphysema. Increased ingestion and assimilation repair pathologic waste, and the increase in weight sometimes exceeds the previous record in good health. Poisonous metabolins, whether autogenetic or heterogenetic, are destroyed or removed. Useful metabolins are again formed. Thus, fever is diminished, sleep is promoted, and night-sweating is often arrested. Hæmoptysis is sometimes checked.

Expiration into compressed air impedes the act and requires greater muscular exertion. If this be sufficient to overcome the obstruction, the amount of air expelled is increased; otherwise it becomes gradually diminished, and the subsequent inspirations are therefore rendered shallower. In other words, tidal air is at first increased, but soon diminished; residual air gradually encroaches upon reserve air, tidal air, and finally upon complemental air, the entire volume becoming practically stationary or residual. The excursions of the diaphragm and thoracic walls become less and less, but at the expense of the contraction, fixed expansion being finally maintained; and if the procedure be pushed to excess with too high a pressure, apnœa may result. Pulmonary ventilation is diminished and gaseous exchange is retarded; the absorption of oxygen by the hæmoglobin being, however, facilitated, although the excretion of carbon dioxide is diminished. The effect upon the circulation is an exaggeration of that produced by inspiration of compressed air, being practically the same as in Valsalva's experiment:—depletion of the lungs and heart; over-distension of the systemic vessels, especially the veins. The pulse may disappear from compression of the subclavian artery. Upon pathologic conditions the pressure effects are similar to those already detailed.

Continuous respiration of compressed air, therefore, greatly augments the distension of the thorax and of the lungs, maintaining the patency of the alveoli; and while it diminishes during treatment the volume of air exhaled, the final result may nevertheless be properly stated as an increase in vital capacity. The ventilation of the lungs is diminished, but, on the whole, gaseous exchange appears to be slightly increased. There is constantly increasing interference with the dilatation of the heart, and an outward pressure replaces the normal thoracic aspiration of the blood, thus blocking the systemic veins, while at the same time the arteries are distended. Arterial tension, increased at first, soon falls, and the pulse becomes small, slow, and feeble.

Inspiration of rarefied air, which should be conducted against a very small negative pressure, rarely exceeding $\frac{1}{60}$ of an atmosphere, increases the muscular effort necessary to produce expansion of the chest and the volume of air needed to supply the proper weight of oxy-

gen. If the requisite effort can be made, there is increase in the elastic tension of the lungs and in the volume of tidal air. If it cannot be made, there is decrease in both these factors. The subsequent contraction of the chest is at first passively facilitated, afterward impeded from the resistance of the denser outer air. The muscular effort of this phase is thus also increased, and the frequency of respiration, at first heightened by the excitement of impediment, is finally diminished. Ventilation and gaseous exchange are, on the whole, increased, vital capacity is augmented, and the muscles of inspiration are strengthened. The blood tends at first to leave the periphery and accumulate within the thorax; but, as there is more blood delivered to the left ventricle, and this can contract with sufficient force to overcome the higher peripheral pressure, the final result is a quickening of the circulation, with an increase in the fulness, blood-pressure, and tension of the arteries.

Expiration into rarefied air, conducted with a negative pressure of from $\frac{1}{60}$ to $\frac{1}{24}$ of an atmosphere, facilitates the contraction of the thorax. It exerts a moderate suction-force, thus greatly increasing the amount of air expelled from the lungs, and facilitating the collapse of distended air-vesicles. Subsequent inspirations are rendered easier and deeper; more oxygen-bearing air enters the vesicles; ventilation and gaseous exchange are enormously increased; and the increase in vital capacity is very great. The circulatory effects are similar to those produced by inspiration of rarefied air, but more marked. They vary in different individuals, are evidently different in man and animals, and can be influenced by the manner of subsequent inspiration. While there are conflicting observations as to systemic blood-pressure, there is agreement as to the tendency to pulmonary congestion and the facilitation of cardiac diastole.

The effect of *inspiration of compressed air, with expiration into rarefied air*, is to increase the efficiency of both processes. The alternating expansion and contraction of the lung-tissue stimulate its elasticity. Pulmonary ventilation, both as to interchange of gases and expulsion of effete materials, is vastly augmented. The alternations of opposing circulatory effects relieve hyperæmia wherever present, increase the activity and penetrating power of the blood-current, and stimulate tissue-change and nutrition.

Inspiration of rarefied air, with expiration into compressed air, increases the muscular effort necessary to complete each act, prolongs the respirations, and retards expiration particularly. The result is to strengthen the respiratory muscles and to improve the respiratory habit. Vital capacity is thus permanently increased. The alternating centripetal and centrifugal impetus increases the activity of circulation.

Inspiration of rarefied air, with expiration into the same medium

(continuous respiration of rarefied air), increases the muscular effort of inspiration, but hastens and facilitates expiration. The centripetal tendency of the blood is maintained during the entire act, and the heart's action is greatly diminished in force and increased in frequency, the general arterial pressure being much lowered.

Facilitation of the respiratory act being the most usual object, *inspiration of compressed air* and *expiration into rarefied air* are the expedients most generally employed, singly or in combination.

Inspiration of compressed air is of benefit in phthisis at any stage short of general softening, with one or more large cavities, but particularly in the early stages, when deficient respiration, impaired circulation, anæmia, and malnutritive dyspepsia in a predisposed subject, suggest tuberculosis even in the absence of pronounced physical signs.[1] It should not be used in acute phthisis or during extensive or active inflammation or softening in chronic phthisis, or in any case marked by continuous high fever. In cases with moderate fever and without very active local changes it may be cautiously employed. I have seen patients whose evening temperature reached as high as 101.5° F. greatly benefited. In slow chronic cases with slight fever, or without fever if there is no active softening in progress, it will often do much good, even should large cavities be present, helping to prolong life and to increase comfort, although recovery may be impossible.

The benefit of this procedure results not alone from the primary effects already alluded to—the opening of disused or occluded air-cells, with increased vital capacity, increased pulmonary ventilation, increased activity of circulation, absorption of inflammatory products, relief of congestion—but also secondarily from the increased appetite; relief of cough, with promotion of sleep; expulsion of septic materials which may directly poison by absorption, or afford a "good culture soil for tubercle bacilli;" and the stimulus to local and general nutrition following the systematic pulmonary gymnastics necessitated.

In hæmoptysis good results have been reported from the inspiration of compressed air and its equivalent—rarefaction of surrounding air in the Brooklyn pneumatic cabinet. Some authors, however, consider a hæmorrhagic tendency to be a counter-indication. My own experience leads me to the belief that when there is any weakness of the pulmonary vessels or any peripheral lesion of hæmorrhagic tendency, or when it is inadvisable to increase blood-pressure in the brain or in the kidneys[2] or other abdominal viscera, the meas-

[1] It may be remarked here that evidences of pulmonary impairment, indistinguishable by the ordinary methods of physical exploration of the chest, may sometimes be detected during inhalation of compressed air—a fact first published, so far as I am aware, by J. Solis-Cohen. (*Vide N. Y. Med. Journ.*, October 18, 1884.)

[2] In one of my cases albuminuria developed during treatment. This may have been merely a coincidence, but at the time I considered it more.

ure is inadmissible. In two remarkable instances, elsewhere cited,[1] I have, however, been forced to credit it with a tendency to the relief of pulmonary hæmorrhage; and this seems to be due directly to the relief of the conditions antecedent to hæmorrhage—namely, pulmonary congestion, with perhaps an exaggerated stasis at one spot from mechanical obstructions affecting that portion of the circulatory apparatus chiefly.

Expiration into rarefied air should be combined with the inspiration of compressed air when it is desired to increase circulatory activity and gaseous exchange or to get rid of accumulating and decomposing matters in the interior of the respiratory viscus. *Expiration into compressed air* should be combined with the inspiration of compressed air when it is desired to relieve congestion or to stimulate absorption, or when increase of vital capacity is the principal object. Alternation of the combinations may be necessary in some instances.

Expiration into compressed air is recommended in cases of deficient normal expiration as a means of strengthening the respiratory muscles.

Inspiration of rarefied air may also be employed when it is desired to strengthen the muscles of inspiration by increased voluntary exercise, as in cases of contracted thorax, in the earlier stages of phthisis, and in convalescence after pleurisy.

That *forced voluntary respiration*, however useful in suitable cases, cannot replace pneumatic treatment by the differential method in cases where the latter is indicated, is evident from the mere statement that it does not produce differential effects; as well as from the fact that many patients are at first incapable of the necessary muscular exertion. As an adjunct or supplement to the differential treatment, or as a means of keeping up the good effects, it often serves excellently.

Temperature and Moisture.—In artificial pneumotherapy the temperature of the inspired air is sometimes of importance. Inhalation of *dry hot air* was recommended by Nicolas Piso[2] (1527–1579), who instanced the case of a woman cured of consumption by attendance on a bakehouse. Allusions to the immunity of limeburners are found throughout literature, and Halter,[3] whose observations in Westphalia cover a period of fifteen years, attributes this partly to the inability of tubercle bacilli to live at the very high temperature of the air about the ovens, and partly to the effects of the rarefied air and high temperature upon the pulse, respiration, and tissue-changes of the laborers during and after habituation. This observer and others have therefore again urged, after the lapse of three centuries and on a new theory, the systematic inhalation of hot dry air as a cure for phthisis. I have not

[1] *Philada. Med. Times*, Feb. 6, 1886, p. 362.
[2] Cited by J. Solis-Cohen, *op. cit.*, p. 371.
[3] *Berliner klin. Woch.*, Sept., 1888.

used the method, and am therefore unable to speak positively. From the contradictory reports[1] of those who have resorted to it I should think it to have a slight value in the early stages of catarrhal phthisis attended with an excess of morbid secretion, but that even this would be very uncertain in any particular case. In late phthisis it seems to be useless, and it has, moreover, the disadvantage of sometimes provoking hæmoptysis. On the whole, its uncertainty and drawbacks seem to preclude its being assigned a permanent or important place in the therapeutics of tuberculosis.

Residence in cow-stables or in apartments directly communicating therewith was recommended by Saiffert,[2] Read,[3] Beddoes,[4] and others in the latter part of the eighteenth century. Beddoes, believing the benefits he observed to be due partly to the uniform warmth of the atmosphere,[5] later kept his patients in rooms where a uniform temperature of from 64° to 70° F. was maintained, the heat being regulated according to the sensations of the patient. Similarly, J. Solis-Cohen[6] has found that when it is impracticable or injudicious to send from home a patient for whom a warm and equable climate during the winter is desirable, much benefit may be obtained by having the patient live in two well-ventilated communicating rooms kept constantly at a uniform temperature. At certain hours of the day, when the outer atmosphere is warmest, say between twelve and two o'clock, the windows may be thrown freely open to secure an ample supply of fresh air, while the patient, putting on hat and overclothing as for a walk in the streets, promenades the room for half an hour or longer. "In this manner the benefit of equable temperature and regular exercise in the open air can be secured without foregoing the comforts of home and the satisfaction of family intercourse. Some [of his] patients have pursued this plan with great advantage, and have apparently done better than they would have done in a milder climate subjected to the discomforts and privations of a boarding-house or hotel-life among strangers, and exposed to the baneful influence of constant or frequent contact with invalids." If to this plan be added—as indeed was done to some extent by both Beddoes and Solis-Cohen—the various measures to secure medicated atmospheres, the inhalation of compressed air, and on unexceptionable days driving or walking out of doors, change of climate will often be admirably substituted.

[1] Krull, *Berlin. klin. Woch.*, Sept., 1888; Jacobi, *Journ. Am. Med. Asso.*, July 20, 1889, p. 104.

[2] Cited by Beddoes.

[3] *Essai sur les Effets salutaire du Sejour des Étables*, London and Paris, 1767.

[4] *Observations on the Medical and Domestic Management of the Consumptive, etc.*, ed. Troy, 1803.

[5] Partly to the reduction in oxygen value, of which more hereafter.

[6] *Op. cit.*, p. 379.

Cold air, as found in mountain climates especially, is tonic and stimulating, and inhalation of air artificially cooled has been recommended[1] in the treatment of catarrhal and inflammatory conditions of the air-passages and of cases of pulmonary phthisis associated with fever and hæmorrhage. I have no experience with this measure.

In making use of inhalations of compressed air by the method earlier described—the supply of air for inhalation coming from the outer atmosphere—moderate coldness (*circa* 50° F.) is not to be dreaded. I have never seen any ill result from it. When, however, the temperature out of doors is very much below that of indoors (less than 50° F.), it is wise, I think, to avoid what might be too great a contrast between the general atmospheric temperature and that of the lungs, and the air from the cylinder should be brought up to the temperature of the room (about 60° F.). It will be somewhat warmed during its passage through the apparatus. When necessary, additional heat can readily be secured by passing the air, on its way from the cylinder to the mouth-piece, through a small coil of glass tubing immersed in hot water in a suitable vessel.

Should it be desired to cool the inhaled air on very warm days—an expedient which is at least perfectly safe if the patient experiences a refreshing sensation—cold water or ice or some freezing mixture may be placed around the coil. On very wet days I sometimes allow the patient to inhale the air of the apartment, but the air from outside may be dried, if desired, by allowing it to pass over calcium chloride before entering the bellows. It will again take up a sufficiency of moisture from the water of the gasometer. A little experience will enable this to be fairly well regulated by "rule of thumb," but, if preferred, a hygrometer may be used. I have not used air artificially dried for therapeutic abstraction of moisture from the air-passages, but I can conceive of the utility of the measure in certain catarrhal conditions. Weber[2] believes part of the benefit of mountain climates to be due to the dryness and coldness of the air.

Chemic Constitution.—The deliberate and systematic treatment of diseases by altering the chemic constitution of the respired air begins with Beddoes's application of the forgotten researches of Mayow and of the brilliant discoveries of Priestly and his contemporaries to "pneumatic medicine."

The theory[3] of this great man—who, it must be remembered, was

[1] Drake, Ramadge, Coxe, Langenbeck, cited by J. Solis-Cohen, *op. cit.*, Philada., 1876, p. 36. Coates (Beddoes and Watts on *Factitious Airs*, Part iv. p. 94) queries whether the cooling of the "hydrocarbonate air" he gave in a case of hæmoptysis, by its passage over cold water in the apparatus, did not make it "like a cold bath, bracing up the vessels of the lungs."

[2] *Loc. cit.*

[3] *Observations on the Nature and Cure of Calculus, Sea-Scurvy, Consumption, Catarrh, and Fever*, London, 1793.

also an enthusiastic advocate of the use of "vital air" in what he deemed to be suitable conditions—that phthisical patients are "hyper-oxygenated," and that this is the cause of the "consumption" of their tissues, and his remark that "it would be no less desirable to have a convenient method of reducing the oxygen to 18 or 20 in 100 than of increasing it by any proportion,"[1] together with his various expedients[2] for modifying the atmosphere in accordance with these views, are forcibly recalled by a number of recent observations.

The theory, as afterward modified by its author, with his usual scientific candor, upon finding that the florid cheeks of hectic might be simulated by other means than the inhalation of oxygen,[3] includes a certain amount of truth; and the practice that he based upon it is unquestionably of permanent value.

This statement at once raises the query as to whether we have not committed ourselves to an exactly opposite doctrine in our study of the means of securing a proper aëration of the blood. The answer is that the whole question hinges upon what is a *proper* aëration, and that we have already seen that while exercise, inhalations of compressed air, and residence at altitudes are beneficial in prophylaxis and in the treatment of apyretic cases, or of cases with but moderate febrile movement, they are counter-indicated in states of excessive or continuous pyrexia. Thus the apparent contradiction disappears.

Premising, therefore, that the method does not belong to preventive, but to remedial, measures, and is here interpolated principally for convenience in discussion, we can take up the subject of

Diminution of Oxygen in Respired Air.—Beddoes,[4] associating with the cessation of phthisical symptoms during pregnancy that he had occasionally noted,[5] his own experience of the physiologic effects of "vital air," Fourcroy's[6] observations of the increased severity of symptoms and greater wasting in consumptives who had been submitted to the inhalation of oxygen, and Percival's contrary experience with the administration of carbonic acid, attributed the phenomenon to abstraction of oxygen from the maternal blood by the fœtus. In his letter to his friend and colaborer, Darwin, he philosophically observes that "there exists a more essential differ-

[1] *Op. cit.*, p. 147. Beddoes estimated the normal percentage of oxygen in the atmosphere at 28.

[2] Beddoes and Watt on *Factitious Airs*, Bristol and London, 1794 to 1796.

[3] *Factitious Airs*, Part i., 3d ed., p. 162.

[4] *Loc. cit.* Also *Letter to Dr. Erasmus Darwin on a New Method of Treating Consumption*, Bristol, 1793.

[5] Hilton Fagge, *op. cit.*, p. 995, alludes to this remission during gestation as "a well-known and very remarkable fact."

[6] J. Solis-Cohen, *op. cit.*, p. 371, from personal experience reaffirms Fourcroy's conclusions. I have made no experience, as the evidence satisfies me.

ence between different cases of phthisis pulmonalis than the British practitioners in general seem willing to admit. Two varieties have lately appeared to me well marked, ... and it is not unlikely they may require a very different method of treatment during the first stage. To the first, which may perhaps be termed 'florid consumption,' the reasoning in my book of observations is exclusively applicable."

Referring for the further marshalling of the evidence and elaboration of the hypothesis to the original writings, it will be sufficient here to recognize that in the fever of tuberculosis, as in all other fevers, there is in truth a morbid katabolism, which is increased by inhalation of oxygen, and, *per contra*, diminished by inhalation of carbon dioxide, nitrogen, hydrogen, and other gases incapable of supporting combustion. Whether the latter effect be due, as Beddoes thought, to the mere absence of oxygen, or to a direct effect of the special gases upon the vital chemistry or the nervous tissues, not even yet, I think, have we sufficient evidence to decide. The comparatively short period during which the cause operates[1] not only makes the effect difficult of explanation on any ground, but has always led to the expression of doubt as to its reality or its permanence. "This difficulty," says Beddoes, "a man who can see but a little way before him will perceive. It has been cleared up by experiment; and I need not hesitate to affirm that the occasional respiration of modified air has a durable effect. But it is nevertheless true that this important subject can never be sifted to the bottom till we have the command of rooms filled with modified air. Useful as diluted hydrocarbonate[2] has proved, no man can say that it would not be more useful if more diluted and respired with greater constancy. The same doubt extends to other airs."

Seeking to carry into practice this theory of the benefit of a "lowered atmosphere" in pyretial diseases, Beddoes finally secured the valuable assistance of "James Watt, engineer," who devised and constructed convenient and practicable apparatus for the manufacture and administration of the different "airs" then known to chemistry. While the use of nitrogen, as the natural diluent of oxygen, was held to be a desideratum, the difficulty then experienced in getting it free from carbonic acid led to the selection of *hydrogen* as the "lowering agent."

This was, however, afterward abandoned for a time in favor of what they called "hydrocarbonate" or "heavy inflammable air," a

[1] Watt, however (*op. cit.*, Part iii. p. 162) suggests that it is "probable that by deep inspiration many of the small vesicles of the lung may become distended and retain the factitious airs" for a certain time.

[2] The inflammable nature of this gas would be an objection to its use in the manner suggested.

somewhat variable and uncertain mixture, which in the opinion of Henry Leffmann [1] probably contained methane or some similar hydrocarbon, hydrogen, carbon monoxide, and carbon dioxide, and, as at first prepared, hydrogen sulphide, from which last, however, Watt afterward purified it.

Beddoes and his correspondents, Thornton, Carmichael, Pearson, and others, administered this "hydrocarbonate" diluted with common air in the proportion of about 1 in 20 (more or less, according to effect produced), giving from one quart to three quarts of the factitious air at a sitting. The patient inhaled the mixture for twenty or thirty seconds continuously, ceasing on feeling the premonitions of vertigo, and inhaling again when these symptoms passed off.

The reports show that it reduced fever, checked cough, relieved pain and dyspnœa, and promoted sleep. Its hypnotic power was so marked as to make Beddoes write: "An atmosphere with a diminished proportion of oxygen is a better soporific than any we at present possess." He narrates the case of a consumptive patient that was able to give up his opium and slept better, while his "healthy servant," the vapors being diffused through the room, "did not know what was come to him, he slept so sound." In some cases it apparently stopped hæmoptysis and night-sweats, and a number of cases are detailed in which complete recovery ensued. Some of these, of course, may in the absence of physical signs, be thought instances of mistaken diagnosis.

Inhalations of *carbon dioxide*, as already mentioned, were employed by Percival,[2] who says that, although he had not been so fortunate as Dr. Withering in effecting a cure, "the hectic fever has been considerably abated and the matter expectorated has become less offensive and better digested." Beddoes and some of his correspondents likewise used this agent with occasional good effect, and the former attributed part of the benefits of residence in and near cow-stables to the carbonic acid exhaled by the cows and given off by the fermenting dung. While he preferred hydrogen as an agent to reduce the proportion of oxygen in the atmosphere, he attributed to carbonic acid a special power in promoting the healing of ulcerated surfaces; fortifying the opinion by records of experiments on blistered sufaces and cutaneous ulcerations, as well as by the citation of pulmonary cases. The administration of carbonic acid by inhalation has been renewed from time to time, Demarquay, Waldenburg, and Dupont having been among those who resorted to it. Demarquay found that he could support for a short time inhalation of a mixture of one-fourth carbonic acid to three-fourths oxygen, while some of his pupils could bear even one in three. For thera-

[1] Personal communication.

[2] "On the Medicinal Uses of Fixed Air," *Essays Medical and Experimental*, London, 1773, vol. ii. p. 72.

peutic use, however, it should not be greater than two parts of carbonic acid to eighteen of oxygen. Twenty litres of such a mixture caused a sensation of heat in the chest, quickened and prolonged expiration, and transient vertigo, preceded by slight cephalalgia. There was no effect on the pulse. The greater proportions of carbonic acid, however, produced more severe vertigo, accelerated, feeble pulse, redness of the face, with some prominence of the eyeballs, and anxious and panting respiration. According to B. W. Richardson,[1] carbonic acid causes coagulation of mucous secretions. Very recently Bergeon's rectal injections of carbonic acid and sulphuretted hydrogen have led to a temporary and limited revival of other methods of administering carbonic acid, to which agent the good results are by some[2] attributed. Were the common notion of the highly poisonous effects of carbonic acid, or the attribution to that gas of the deleterious effects of a vitiated atmosphere, correct, there would be an obvious objection to its employment by inhalation. But the experiments of the observers quoted, the experience of J. Solis-Cohen and James Collins,[3] together with the observations already cited of B. W. Richardson upon "rebreathed oxygen," and of Brown-Séquard and D'Arsonval, tending to show that some product of katabolism other than carbonic acid is the most powerful toxic agent in unventilated places, are sufficient to set this objection aside. In medicinal dilution and usage carbon dioxide is not poisonous. The anæsthetic properties of carbon dioxide, and its power to promote cicatrization, are now frequently used in the treatment of burns, gangrene, and the like.

Brown-Séquard[4] said, in a discussion at the Biological Society of Paris, that in an atmosphere containing too great a proportion of oxygen irritation resulted, causing considerable distress even when the carbonic acid eliminated remained normal, but that if a mixture of carbonic acid and oxygen be made in determined proportions in an artificial atmosphere, these phenomena of intolerance are no longer produced. "It is possible to comprehend how in cases of tuberculosis a diminution of reflex sensibility, and consequently a lessening of cough, may be produced, while at the same time the pulmonary lesions may be favorably influenced by carbonic acid." This is an exact reproduction of the observation and argument of the founders of "pneumatic medicine." Inhalations of carbon dioxide may therefore be employed, as indicated by them, as a sedative and to promote cicatrization of ulcerations. A convenient use will be that of Cohen and Collins,[5] of the compressed gas in place of compressed air to drive the sprays used as detergent washes or as medicinal inhalations.

[1] *Asclepiad*, vol. vi., 1889, p. 84.
[2] Dupont, *Bull. gén. de Thérap.*, cxii., 1887, p. 24.
[3] J. Solis-Cohen, *op. cit.*, p. 86.
[4] Cited *Lancet*, Nov. 19, 1887.
[5] *Loc. cit.*

D'Arsonval[1] has described a special apparatus for regulating the composition, temperature, and humidity of the respired air, and furnishing an exact record of the oxygen and carbonic acid exhaled and inhaled. Carbonic-acid waters, natural and artificial, offer a convenient method of introducing the gas into the stomach, or, following Hugo Weber,[2] a teaspoonful of sodium bicarbonate may be given before meals immediately after a glassful of water containing twelve drops of hydrochloric acid has been swallowed; or the method of Bergeon may be utilized. Greater attention should be paid to this agent by those who do not seek for impossible panaceas, and can use it, therefore, for definite ends, palliative or curative as may be, and be satisfied with attainment of the ends aimed at. It is well to relieve even when we cannot cure.

Nitrogen monoxide (nitrous oxide) is a constituent of the "compound oxygens" and similar mixtures exploited by charlatans, and within recent years applied with some degree of success in legitimate practice. Its well-known anæsthetic properties give it a certain positive value of its own, apart from the reduction in the proportion of oxygen inhaled, that may be accomplished by its use; and cylinders containing it under pressure may now be so readily obtained that its use is very convenient. Since the time of Beddoes and Davy it has been employed in medicine, though chiefly in nervous affections, whether of the respiratory tract, as asthma and whooping cough, or of other organs. Lavison[3] recorded a case of recovery in miliary tuberculosis under inhalations of five gallons of the gas daily at intervals. Klikowitsch[4] has employed it in phthisis with "favorable results." He adds 20 per cent. of oxygen, which "obviates all danger of asphyxia, and produces several effects, some advantageous in therapeutics." J. Solis-Cohen has for many years used it in pulmonary and laryngeal phthisis as a sedative. He gives from one to three gallons, mixed with equal or double quantity of air, usually at bed-time in order to secure sleep free from harassing cough. The gain in weight and other improvement noted he attributes to the rest thus obtained.

I have occasionally resorted to inhalations of this agent, pure or mixed with air or with oxygen in various proportions, to relieve excessive nervous irritability, manifested by cough, dyspnœa, or insomnia, and have incidentally observed reduction of fever; but I have not pushed the method as it deserves. As Klikowitsch observed, "it renders respiration slower and deeper, and if the pulse-rate diminishes the pulse becomes larger and fuller."

[1] *Comptes Rendus de la Soc. de Biologie*, 8 S., t. iv., p. 751.

[2] *Berlin. klin. Woch.*, Sept. 2, 1889.

[3] *Cincinnati Med. News*, Nov., 1874, cited by J. Solis-Cohen.

[4] Cited by Hassall, *Inhalation Treatment*, London, 1885, p. 134; *Virchow's Archiv*, vol. xciv. pp. 148 and 227; *Practitioner*, Mar., 1884, p. 218.

Nitrogen.—Though a mixture of nitrogen and carbon dioxide was employed by Beddoes and his contemporaries, pure nitrogen has had little use in medicine. According to Treutler,[1] its inhalation causes paleness and coldness of the skin, small, frequent pulse, and vertigo followed by headache, but never by syncope. Immediately after the inhalation there is a feeling of comfort and greater freedom in breathing, with some lassitude. It is a sedative by diminishing irritation through the exclusion of oxygen. Kohlschütter administered about one hundred and twenty litres of a mixture containing 90 to 96 per cent. of nitrogen and the balance oxygen. It should be inhaled for half an hour daily for not less than four weeks. He observed, as did Treutler, quiet sleep, increased appetite, diminution of cough, of night-sweats, of fever, and of diarrhœa, increased lung-capacity and augmented body-weight. Oertel likewise finds this agent of use in reducing local inflammation and suppuration and mitigating symptoms of irritation in general. Holzhauer[2] employed a pneumatic chamber into which nitrogen was introduced in certain proportions, not for its own value, but to reduce the oxygen-proportion of the atmosphere. He observed mitigation of symptoms and increase of weight, at times resorption of infiltrates. Sieferman,[3] as likewise Krüll and Mermagen, observed, from inhalation of a mixture of nitrogen (2 to 7 per cent.) with air, similar results to those of all the observers cited. Only in weak and anæmic patients were unpleasant sensations produced, and not after the first two or three sittings. The last-mentioned observers report disappearance of apical dulness.

Valenzuela,[4] believing the beneficial effects of high altitudes to be due less to the mechanical effects of a rare atmosphere than to the absolute diminution of respired oxygen, has devised an apparatus for the inhalation of *suboxygenated air*. To facilitate directions to patients he terms the process "inhalation of nitrogen," but physicians must understand that the therapeutic effect is not due to any positive quality of nitrogen, but to its negative quality—namely, the diminution of oxygen.

In the communication cited Valenzuela gives the fruit of eight years' laboratory studies and four years' practical therapeutic experience. I have as yet no personal experience with the method, but the scientific tone of its author's paper, the inherent probability of much of his reasoning, and the very favorable results reported lead me to believe it a decided addition to our resources, and I shall therefore devote to it enough space to present it fairly.

In Spain the mortality from tuberculosis is about 20 per cent. of the total mortality in localities not more than 300 feet above sea-level, not-

[1] Cited by Hassall, *op. cit.*, p. 137.

[2] *Aertz. Mittheil. a Baden*, 1887, Nos. 8–12, cited by Wesener.

[3] *Gaz. méd. de Strasb.;* cited in *London Med. Record*, May 15, 1885.

[4] *C. R. Cong. p. l'Étude de la T.*, t. i. p. 653.

withstanding the ideal mildness of the climate of such regions as Malaga, Seville, and Valencia. At an elevation of about 1500 feet the proportionate mortality of tuberculosis falls to 10 or 12 per cent.; at about 3000 feet it reaches only 1 or 2 per cent.; and in regions more than 3900 feet above sea-level tuberculosis is entirely unknown in Spain, notwithstanding extreme variability, humidity, and rigor of climate in many such regions. Allowing for difference of pressure, air containing 17 per cent. of oxygen at sea-level is equivalent in oxygen-value to the atmosphere of 5500 feet elevation; 16 per cent. of oxygen is equivalent to about 7000 feet elevation; and 12 per cent. of oxygen represents an altitude of about 15,000 feet. These may be termed, respectively, moderate, high, and extreme altitudes. The physiologic effects of the atmosphere of the respective altitudes and of air deprived of its oxygen in the proportions indicated, Valenzuela states to be identical. These effects he thus summarizes:

Moderate Altitude (17 per cent. O) stimulates respiratory movements, increases thoracic expansion, and augments excretion of carbon dioxide and of urea.

High Altitude (16 per cent. O) stimulates more markedly the respiratory movements, and diminishes nervous excitement, but does not modify nutrition.

Extreme Altitude (12 per cent. O) renders respiration extraordinarily active, disturbs the regularity of the circulatory rhythm, depresses markedly the nutritive movement (metabolism), diminishes temperature, sensibility, reflex excitability, and all other functions, and frequently produces epistaxis—a group of manifestations known as "mountain-sickness." These effects, Valenzuela asserts, are shown to be independent of diminution in pressure.

To avoid elaborate apparatus, Valenzuela makes patients manufacture their own suboxygenated air by the very simple procedure of exhausting the oxygen by respiration. Carbon dioxide, water, and volatile principles, the products of respiration, are removed by fixation with caustic soda, condensation by cold, and solution in the condensed aqueous vapors respectively. From foreign bodies the air is purified by filtration.

The apparatus consists of a porcelain vessel of twelve quarts' capacity, so constructed that the contained liquid exposes a large surface to contact with the air; a rubber-bag to receive and retain the expired air; and a tube of the same substance with a porcelain mouthpiece. A solution of caustic soda being introduced into the apparatus, the patient respires. The carbon dioxide is absorbed by the soda, the air of the apparatus commences to lose its oxygen, and, if not renewed, would become irrespirable, being converted into almost pure nitrogen in the course of about three minutes. To avoid this, and at the same

time to reach and maintain a fixed proportion of nitrogen and oxygen, Valenzuela has devised a pair of valves, one of which permits a certain portion of the expired air to issue from the apparatus, while the other allows an equivalent volume of fresh air to replace it at the following inspiration. Without intending it, the author appears to have thus avoided the dangers of rebreathed oxygen. The apertures of the valves have been carefully calculated and the result verified by chemical analysis. There are three sets of valves, producing respectively the three proportions of oxygen already mentioned—12 per cent., 16 per cent., and 17 per cent.

The apparatus is placed in the patient's chamber, so that he may use it at any hour of day or night for an appreciable time. Two hours daily, divided into three or four sittings, is estimated as the minimum time to be devoted to the use of the apparatus, and two months the least time of uninterrupted treatment. Much more than this is desirable.

Valenzuela has collected statistics of 1000 cases treated by himself and others, with 74.8 per cent. of favorable results, composed of cases of definite recovery and cases of improvement in the proportion of 2 to 3. In patients in whom the tuberculous process is of slow evolution, and who are early submitted to respiration of suboxygenated air—at a time, that is, when general nutrition is conserved and there is no fever, and they are considered as invalids only because of cough and hæmoptysis; in whom, nevertheless, the diagnosis can be established by physical, spirometric, and microscopic evidence—recovery is the rule.

The effects of this treatment upon pathologic conditions are said to be notable. In the first few days the cough disappears; dyspnœa is no longer experienced upon exertion; intercostal neuralgia is relieved; color returns to the skin and mucous membranes; weight, chest expansion, and vital capacity augment. The patient becomes less susceptible to cold. Urinalysis shows more perfect oxidation of residual products, inasmuch as urea is increased and uric acid diminished. Even in advanced periods of the disease the treatment diminishes fever, checks sweating, and aids nutrition. Marked improvement, characterized as "temporary recovery," has been obtained. In acute tuberculosis the treatment is powerless. Valenzuela has attempted to combine with this method antiseptic inhalations, but his results are not definitive.

These observations of Valenzuela's are somewhat confirmatory, somewhat contradictory, of our reasoning hitherto, inasmuch as he finds not only, like Beddoes and his correspondents, diminution of the hectic fever and its concomitants, but also in early apyretic cases symptomatic improvement, and even recovery; while increased and not diminished oxidation is apparently shown by the urinalysis. This latter, however,

may—and indeed this is the author's language—be *more complete* oxidation of tissue consumed, and yet consumption of a lessened quantity.

It may be urged too, with some show of reason, especially in view of the fact that febrile cases do badly at altitudes, that the different physical conditions presented by the lungs at different stages in the disease constitute a sort of automatic adjustment to medicinal inhalations of suboxygenated air. In the earlier period of phthisis increased expansion is brought about, and the continuous after-effect of this is to increase the respiratory capacity, and hence the volume of oxygen inhaled and associated with hæmoglobin. In the later period this increased expansion cannot occur, and the amount of absorbed oxygen is directly diminished for the time, while the sedative effect on the nervous apparatus reduces the energy of morbid combustion.

Impregnation of Air with Medicinal Agents.[1]—The subject of artificial climatotherapy, in so far as it relates to the treatment of tuberculous diseases, must include not merely modifications in the physical condition of the atmosphere and in the relative proportions of its universal chemic constituents, but also the addition to it of various gases and vapors in imitation of the atmospheres of certain regions supposed to possess healing virtues. Three principal methods, each capable of being carried out in a variety of ways, may be adopted to medicate the atmosphere respired by the patient. (1) The medicinal vapor may be diffused through the air of the apartment. This, when possible, is preferable. In pneumatic chambers it is usually conjoined with the compressed-air bath. (2) Resort may be had to intermittent inhalation of gases, vapors, fumes, sprays, etc. by means of suitable apparatus. (3) Continuous inhalation may be attempted by means of devices for surrounding the person of the patient with a medicated atmosphere, or for causing the air, as it enters the nasal passages, to take up the medicinal vapor. The most appropriate or feasible expedients will be mentioned in connection with the agents discussed. We shall take up only those agents which I consider of proved utility.

Homer sang the virtues of *sulphur*. Galen sent patients with phthisis and with laryngeal and tracheal ulcerations to the vicinity of Mount Vesuvius and to that of Mount Ætna, that they might breathe the sulphurous emanations. Sulphuretted hydrogen vapors probably formed a portion of Beddoes and Watt's "hydrocarbonate air," as Watt, indeed, shrewdly suspected; and they are among the many constituents of the air of cow-stables and of the gases that were generated in the rooms where "hotbeds" were introduced in imitation of cow-stables. Sulphur springs in Europe and America have long had deserved repute in

[1] Where original reference is not given in discussing this subject the citation is from J. Solis-Cohen's treatise on *Inhalation*, 2d ed., Philada., 1876.

the treatment of diseases of the air-passages. Baumes[1] said that those engaged in sulphuric-acid manufacture were protected against phthisis, or, if affected, recovered; and Julius Kircher,[2] a manufacturing chemist in Brooklyn, states that a large quantity of sulphur is vaporized daily in his establishment, and during forty-four years he has had no laborer affected with consumption, while many entering his employment in the early stage of the disease have recovered and become strong and stout. Thus from time to time hydrogen sulphide (sulphuretted hydrogen) and sulphurous anhydride (gaseous sulphurous acid) vapors have been urged, dropped, and again urged in the treatment of various forms of pulmonary disease, including consumption. That they are of great value in controlling the suppurative and putrefactive processes that accompany pulmonary tuberculosis in the stage of softening, I am convinced, not alone by the records of centuries, but also by my own experience with the method of treatment recommended by Bergeon.[3]

Except at the inhalatoria of certain springs,[4] where by various methods the air is laden with finely-divided spray, and in some cases sulphurous anhydride or hydrogen sulphide thus liberated, the difficulty in practical application of sulphur inhalations lies in the noxious odor of sulphuretted hydrogen, and the irritating and sometimes toxic qualities, when inhaled, of both this gas and sulphurous acid. With due care, however, the difficulties can to some extent be overcome. A few of the best expedients may be mentioned. Any of the sulphuretted mineral waters, or an artificial sulphur-water, or the Pharmacopœial solution of sulphurous acid, may be inhaled in the form of spray. It is better, however, to diffuse sulphurous anhydride through the air of the apartment, and, if possible, mingled with carbon dioxide. For this purpose 10 parts of flowers of sulphur, slightly moistened with alcohol, may be burned with 1 part of charcoal in an open vessel. Dewar sprinkled sulphur in successive small quantities on red-hot cinders contained in a kitchen shovel placed upon a stool in the middle of the room. Dujardin-Beaumetz[5] burned in a close room 150 grains of sulphur for every cubic yard of space (250 grammes in a room of 25 cubic metres' capacity), and twelve hours later had the patient enter the room and remain for four hours. Kircher[6] recommended as a practical expedient that patients should remain in a room where hourly one to two drachms of sulphur are vaporized on a warm stove. Burning carbon-disulphide with a wick in a lamp is one of the best methods,

[1] Cited by Coxe, on *Inhalation*, Philada., 1845, p. 135.

[2] Cited in *Med. and Surg. Rep.*, Nov. 25, 1882.

[3] *Vide infra.*

[4] In America the Sharon Springs are now in possession of a well-fitted establishment. Mt. Clement ought to be.

[5] *N. Y. Med. Journ.*, Sept. 22, 1887, p. 354.

[6] *Loc. cit.*

as it likewise diffuses carbon dioxide; and whether this or other expedient be chosen, some of the irritating effects may be mitigated by burning at the same time opium and gum benzoin[1] (Auriol). If necessary the windows may be opened from time to time.

The "Pictet liquid," which consists of a mixture of sulphurous acid and carbonic acid liquefied under pressure, was at one time obtainable in Philadelphia in syphons like those in which mineral waters are supplied. Acting upon a suggestion of my teacher, Bartholow, I made a few trials of a method of using this liquid, which promised to give satisfactory results; but, unfortunately, I have not been able to obtain a further supply of the compressed gases. The windows of a small room being closed, the room vacated, and the door shut, a tube connected with the delivery-nozzle of the syphon was passed through the keyhole, and, the released liquid quickly resuming the gaseous state, a certain quantity—arrived at by experiment as to the tolerance of the individual—was allowed to diffuse through the atmosphere of the room. The patient then entered and remained as long as possible, from a few minutes to a few hours, varying with the amount of gas diffused and the individual tolerance. This method ought, I think, to be pushed further, as it is one of the best means of securing such a dilution of the gas as will be easily and continuously respirable. Another method is to mingle sulphurous acid with carbonic acid and air in a suitable container, from which the patient may inhale, but this is a difficult and annoying process.

"*Sulphuretted hydrogen*[2] in small quantities is stimulant, reduces the frequency of the pulse, increases the secretion of the mucous membrane and skin, and promotes expectoration; its inhalation gives rise to a feeling of comfort and enables the patient to inspire more freely. In large quantities it depresses powerfully and is dangerous." Beddoes and Watt[3] frequently observed transient vertigo, and even syncope. A patient at the University Hospital, Philadelphia, was profoundly prostrated, but recovered, from the injection *per rectum* of one quart of equal parts of hydrogen sulphide and carbon dioxide.[4]

Sulphurous acid is classed among disinfectants, and its virtues are usually attributed to its deleterious influence on low forms of life and its power to destroy certain organic matters by combining with oxygen. Inhaled undiluted, it produces spasm of the larynx, and, if in sufficient quantity, violent inflammation of the air-passages. I have never been able to remain, except for a very short time, in a sulphurous atmosphere, owing to severe irritation of the conjunctivæ, even when the throat was not affected. Hence it is difficult for me to persuade patients to do

[1] *Brit Med. Journ.*, March 17, 1888.

[2] Arthur Hill Hassall, *Inhalation Treatment*, London, 1885, p. 141.

[3] *Op. cit.*

[4] H. C. Wood, *Therapeutics, etc.*, Philada., 1888, p. 770.

what I cannot. There is, however, an available method of obtaining within the patient a sulphuretted atmosphere, which we owe to the ingenuity of Bergeon[1] of Lyons. Taking the suggestion from the observation of Claude Bernard, that when gases, otherwise poisonous, are introduced into the large intestine they will be absorbed into the blood, and eliminated by way of the lungs without reaching the arterial circuit, Bergeon has advocated and practised the administration *per rectum*, for local effect upon the entire respiratory tract, of a mixture of hydrogen sulphide and carbon dioxide, free from air. Unfortunately, the notoriety given this treatment by American newspapers, the methods of some who practised it, its exploitation by instrument-makers—some of whom furnished very defective apparatus—and its irrational and indiscreet handling by some incapable of judgment, have brought it into ill repute. I desire to reaffirm here what I have elsewhere[2] said concerning it—namely, that as an auxiliary to other methods of treatment it is of great usefulness in certain conditions: not all the observers[3] who found it of benefit were inexperienced incapables or unbalanced enthusiasts. It is probably, as claimed, without influence on tubercle bacilli, but it does most certainly help to control suppuration and putrefaction in phthisical cavities, to stimulate healthy secretion of the respiratory membranes, and to heal laryngeal ulcerations. Symptomatically, it reduces cough, checks diarrhœa, lowers temperature—often amazingly—promotes sleep, increases appetite, and, if proper food be given, is followed by gain in weight. Before softening, however, it is unnecessary; and in cases far advanced it is unavailing as a curative measure, though useful in palliation. In what may be generalizingly called "second-stage" cases it helps the cure, however, in two ways—through the cicatrizing properties of carbonic acid, pointed out by Beddoes and confirmed by a hundred years' experience; and through the action of the sulphur gas in combating the septic decompositions that are superadded to the tuberculous degenerations and phthisical excavations. In order to obtain pure carbonic acid, Bergeon deemed it necessary to evolve the gas at or about the time of administration. Having been collected in a rubber balloon (I, Figs. 158 and 159), this is then passed by means of a hand-bellows (J), through a flask (G) of warmed natural or artificial sulphur-water, and, taking up the hydrogen sulphide on its way, the two are slowly introduced into the

[1] *Comptes Rendus de l'Acad. des Sci.*, t. ciii., Paris, 1886, p. 176 et p. 659; *Bull. de la Soc. Anat. de Paris*, 4 S., t. xi., 1886, p. 609.

[2] "Recent Advances in the Treatment of Pulmonary Consumption," *Trans. of the Medical Society of the State of Pennsylvania*, 1887.

[3] Burney Yeo, C. Henry Bennett, Sinclair Coghill, J. Solis-Cohen, De Renzi, Cornil, Bruen, and many others. See reports, good, bad, and otherwise, collected in Wesener's admirable epitome of "Die Antiparisitaire Behandlung der Lungenschwindsucht," *Centralbl. f. Bacteriologie und Parasitenkunde*, No. 16, Band iv., 1888.

rectum. From two to six quarts of carbon dioxide are used, and a sulphur-water about the strength of that of Eaux Bonnes.[1] Care must be taken that all air is ejected from the apparatus before the delivery-tube is placed in the rectum. From ten to twenty minutes are consumed in each injection, and two injections[2] are made daily.

Morel[3] devised an apparatus which is sufficiently well shown in the figures not to need further description, and Wilkerson of Baltimore a better one, which, unfortunately, has not been placed on the market, owing to the falling off of professional interest.

[1] The Mt. Clement is the best American water. A good formula for artificial sulphur-water for this purpose is that suggested by Bardet and modified by Yeo: Add to 8 fluidounces of water 3 fluidrachms each of the following solutions:

No. 1.		*No. 2.*	
Sodium sulphide, *c. p.*,	℥ss;	Tartaric acid,	℥j-℥ij;
Distilled water,	f℥vj.—Mix.	Salicylic acid,	ʒss;
		Distilled water,	f℥vj.—Mix.

[2] Morel (*Nouveau traitement . . . . par les injections rectales gazeuses, etc.*, Paris, 1886) gives the following directions:

"This operation demands a certain amount of experience and several precautions. The patient should be as much disrobed as possible, or at least not wear any dress, corset, or belt that would compress the abdomen, which necessarily swells a little on the entrance of the gas into the large intestine. It is best that he should lie on his back.

"When an injection is made for the first time it is well to note with the hand the resistance made to the entrance of the gas into the intestine—to go slowly or to stop a little if the resistance be very great, which announces that the intestine is filled, and to wait until the absorption takes place, and then resume again, and so on.

"It is also necessary to note the sensations of the patient—to stop quickly if he is attacked with colic or has an inclination to stool. In some cases this is so imperative that it has to be obeyed, and in this case, when the intestine has been emptied, the injection is resumed. It is not necessary to take evacuants before the injection. In cases, where the extent of the pulmonary lesions is very great, and in consequence the gaseous elimination is made but slowly, it is necessary to proceed very slowly on account of the sensation of fulness in the chest and abdomen. It is necessary to take fifteen to twenty minutes to administer the first injection.

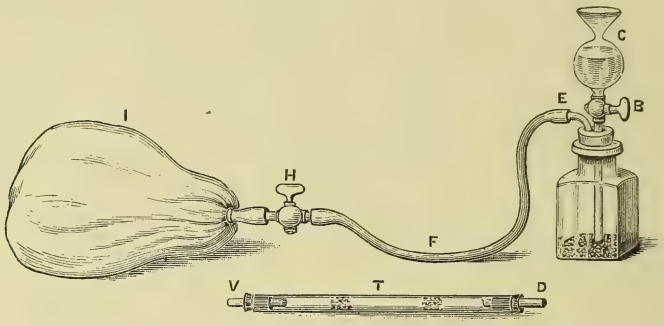
"The first operation at least should be made by the physician himself, in order that he may take note of the susceptibility of the patient to the action of the gas, the rapidity with which the absorption and elimination take place, and the manner in which the intestine tolerates the gaseous mixture. It should not be confided to the patient nor his attendants until the physician is able to give them precise instructions. He should not give over these injections into the hands of the patient, any more than he would the administration of hypodermatic injections of morphine or other substances of the same kind. In one case as in the other serious accidents might result if account were not taken from time to time of the conditions that affect and result from the injections—conditions that vary necessarily in one patient and another, and for which general rules cannot be given.

"The rectal injections should be made three or four hours after meals or immediately before them. If taken too soon after meals, they are likely to produce vomiting, if nothing worse. For the first injection it is well to use only part of the volume of carbonic acid in the gas-bag, say about three litres. After three or four operations an injection of six litres is readily tolerated morning and evening." The mineral-water bottle should be kept in a hot-water bath in order to maintain the gases at a temperature of about 100° F.

[3] *Op. cit.*

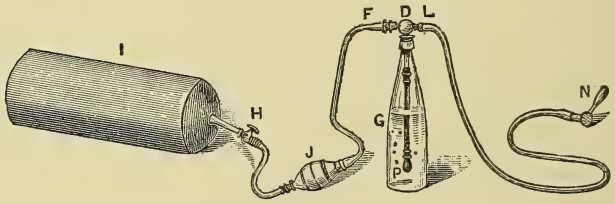
Other medicaments[1] can likewise be introduced by the carbonic-acid enema, the wash-bottle being replaced by a glass tube (T, Fig. 158)

FIG. 158.



Generator and Reservoir.

FIG. 159.



Reservoir and Injection Apparatus.

Morel's Apparatus for Rectal Gaseous Injections.

enclosing the substance between two tampons of cotton and fitted with smaller glass tubes (V and D) for the attachment of rubber hose..

The survival and revival in various forms of the sulphur-and-carbonic acid treatment certainly indicates that it has a place in the management of phthisis. The disappointment leading to temporary abandonment is due to the irrational expectation and pursuit of specifics. This is not a specific, and hence those who "try it" as such will never persevere.

H. C. Wood[2] says: "The method of administration proposed by Bergeon is barbarous and possesses no advantages whatever. A much better method is the exhibition of sulphuretted hydrogen by the mouth by means of water saturated with sulphuretted hydrogen and carbonic acid gas. This water is very readily prepared by a small apparatus, is not objected to by most patients after the first day or two of its taking, and usually does not disagree with the stomach, although there are cases

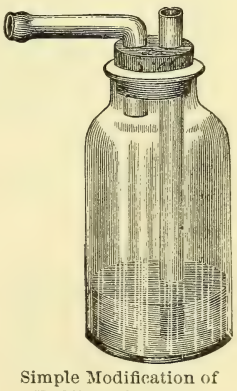
[1] Morel (*loc. cit.*) uses for each injection 1 tea-spoonful iodoform, or 20 to 25 drops of carbon disulphide or of eucalyptol highly rectified.

[2] *Op. cit.*, p. 770.

in which it causes so much abdominal disturbance that it has to be abandoned. The dose of the saturated solution is two to four ounces three or four times a day. After the larger doses the odor of the gas upon the breath becomes very perceptible." Garnet[1] having found inhalations of sulphuretted hydrogen beneficial, gave Harrowgate waters internally, and later a mixture of sulphurated potassium and charcoal, the latter being thought by him to abstract oxygen from the blood, forming carbonic acid.

IODINE, BROMINE, CHLORINE, AND FLUORINE.—Laennec, believing that the *iodized vapor* escaping from seaweed was the curative agent in seacoast atmospheres, attempted to make an artificial sea air for consumptive patients by heaping varec in their apartments, and especially about their beds. Richardson[2] produced a factitious marine atmosphere by diffusing through the air of the sick-room, at the rate of 2 fluidounces of the solution in 15 minutes, a steam- or hand-spray of *hydrogen dioxide* (10-vol. sol.), containing 1 per cent. of *ozonic ether*, *iodine* to saturation, and 2.50 per cent. of *sea salt*. Piorry, who claimed much benefit from the direct inhalation of iodine, desired his patients not to be deprived of its benefit during sleep, and had several saucers containing it placed about their pillows. In the hospital he attached a number of open vials of iodine to the iron frames supporting the bed-curtains. Sir James Murray secured an iodized atmosphere by placing an open capsule containing iodine in a vessel of hot water, or a vessel containing iodine in such a position as to become traversed by a current of steam escaping from a vessel in its neighborhood. Part of the benefit obtained he attributed to the equable temperature thus maintained in the patient's apartments. De Renzi[3] placed a capsule containing iodine in a sand-bath, and volatilized from 6 to 32 grains daily in a room of about 900 cubic feet capacity.

FIG. 160.



Simple Modification of Wolff Bottle Inhaler.

Corrigan's apparatus, or some modification of it—as, for instance, the use of a chemist's glass funnel with regulating stopcock (*vide* Fig. 158) in place of the globe and wick—is one of the best that can be used for this purpose. A porcelain dish containing water is supported at the proper height above a spirit lamp, and the medicinal solution drops through a cotton wick from a globe above, into the boiling water in the dish. Scudamore was enthusiastic in the praise of iodine inhalations. He mitigated the irritating qualities of the vapor by adding a small quantity of tinc-

[1] Beddoes and Watt, *Factitious Airs*, Part i., 3d ed. p. 119, *seq.*

[2] *Brit. Med. Journ.*, Aug. 19, 1865; *Asclepiad*, vol. i., 1884, p. 209.

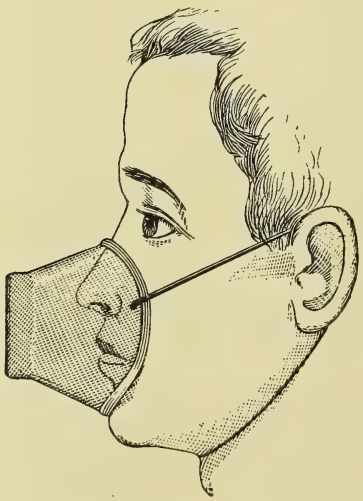
[3] Cited *Lancet*, July 25, 1885.

ture of *conium* at the moment of inhalation. His method was to throw on warm water, in a stoppered vessel furnished with two tubes, from 1 to 4 drachms of a solution containing 6 grains each of iodine and potassium iodide, with 2 drachms of alcohol in 5 ounces of distilled water. The process was repeated three or four times a day. This simple means of vaporizing suitable substances is one of the best, and an inhaler such as is shown in Fig. 160, can be readily extemporized.

Many others have reported favorable results from the employment of iodine inhalations, and, though so eminent a man as Stokes reprobated the practice, there can be no doubt of its great utility. I have no satisfactory explanation to offer, and abstain from unverifiable conjecture. The fact is certain. J. Solis-Cohen,[1] who reports good results in the chronic laryngitis of tuberculosis from inhalations of iodine in combination with carbolic acid, points out that much of the benefit derived from painting tincture of iodine over the chest may be justly attributed to the inhalation of the vapor of the iodine thus employed, especially when the application is made at night. Leigh, indeed, rubbed iodine ointment upon the chest and into the axillæ, so that the patient could breathe the vapor by placing his head beneath the bed-covering.

My own resort to an iodized atmosphere is chiefly by means of *ethyl iodide*. The use of this drug (then called hydriodic ether) was urged as long ago at least as 1849 by Huetle, who put a spoonful of water with seven or eight drops of the ether, which is of high specific gravity, into a wide-mouthed jar. The ether falling to the bottom, the patient inspired the air contained in the upper part of the glass, holding the bottom of the jar in his hand to favor volatilization. In ten minutes the whole of the ether is absorbed, and fifteen minutes later iodine may be found in the urine. Ethyl iodide may now, like amyl nitrite, be obtained in glass capsules containing five minims of the drug, which may be broken in a handkerchief or on a piece of cotton-wool at the moment of inhalation. My own custom is simply to have the patient hold to his nose or mouth an open ounce-vial containing the medicament, which he thus inhales as it

Fig. 161.



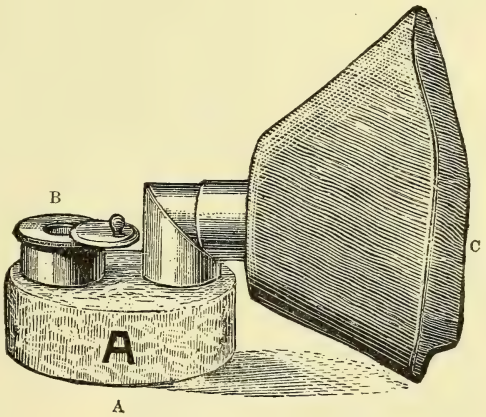
Yeo's Perforated Zinc Respirator.

[1] One or two grains of carbolic acid, ten or more drops of tincture of iodine or compound iodine-water, thrown on hot water in any convenient vessel. *Op. cit.*, p. 109.

becomes volatilized. This is kept up for about five minutes, unless vertigo or unpleasant symptoms are produced—a rare occurrence. The inhalation is made frequently, as often as every half hour in some instances, and usually every second hour. It is useful in chronic pneumonia and early tuberculosis, and of special benefit in ulcerative laryngitis and in assisting the disinfection and healing of pulmonary cavities. I also use ethyl iodide freely on the respirator (Fig. 161) devised by Burney Yeo,[1] one of the most useful, as it is one of the simplest, devices for the inspiration of medicinal vapors. It is, as will be seen from the illustration, simply a cage of perforated zinc bound with cloth or chamois-skin, carrying a sponge, and fitted with elastic loops to attach it around the ears, so that it fits over the nose and mouth. The respired air becomes impregnated with the vapor of any volatile medicament dropped upon the sponge, and as the little cage, being light and cleanly, can be worn for prolonged periods, a continuous medication of the respiratory tract is thus effected.

Quite a convenient apparatus for inhalation of ethyl iodide, ammoniated chloroform, ethereal solutions of resins, and similar volatile substances is the "bead inhaler" (Fig. 162) of B. W. Richardson,[2] which consists of a glass receiver (A) shaped like an inkstand; having a neck (B) with regulating cap through which liquid is poured into the receiver; and a mouthpiece (C) fitted inside with a talc inspiratory valve and with an expiratory valve. In the receiver is placed a string of glass beads held on a line of cotton wick or floss silk. The beads fill the receiver and form a free surface for the volatile fluid, without danger of the escape of the fluid, except in the form of vapor, during the inhalation. From twenty minims to one or two fluidrachms of the required volatile fluid may be poured on the beads. When the instrument is not in use the cap is closed. In administering inhalations the cap is turned aside much or little as may be required.

FIG. 162.



Richardson's "Bead-Inhaler."

[1] *British Medical Journal*, July 1, 1882. J. Solis-Cohen and I began using it immediately after Yeo's publication, and our results after two years' experience were reported by me in *The Medical News*, October 11, 1884.

[2] *Asclepiad*, vol. i., 1884, No. 7, p. 33.

Iodoform dissolved in ether, chloroform, turpentine (sufficiently diluted), or some vegetable or petroleum oil, may likewise be used as an inhalation in spray or nebula, or the powder may be inhaled or insufflated with the aid of compressed air. I shall speak of this agent more at length in another connection.

Bromine is supposed to be a constituent of sea air, and is found in certain springs. It is an efficient disinfectant, and would be useful, I have no doubt, in tuberculosis. Too great pungency, however, and its general unmanageableness constitute great drawbacks to its use, while ethyl bromide is too powerful an anæsthetic to be used similarly to the iodine-ether. *Bromoform* might be tried, but I have thus far found it too irritating to the conjunctiva to persist in its use. It does not seem to irritate the nose or throat. The method recommended by Ozanam for bromine inhalations in croup would probably be the most available in cases of phthisis in which there was no objection to the steam. Putting into a bowl of boiling water a large pinch of potassium bromide or of common salt, he then adds gradually, two or three times during five or ten minutes, a teaspoonful of an aqueous solution of bromine, one drop to the ounce. The vessel is covered with a funnel of glass or paper, and the patient inhales the vapor slowly and deeply. Mixed with the steam of the water, it does not produce irritation.

In 1819, Gannal observed that persons who suffered with chest diseases were visibly improved by working in a bleaching establishment. He thus was led to employ inhalation of *chlorine* in the treatment of consumption. His results were good, and his communication to the Parisian Academy of Sciences in 1828 secured the introduction of the agent into medical practice. Laennec mentioned it both favorably and unfavorably. It was employed by Louis, who at first commended it, and afterward withdrew his commendation. Stokes opposed its use, as he did that of iodine. Like many other useful agents, it has been over-lauded and over-neglected. Recently Shurly [1] and Gibbes have prominently recalled attention to its merits. The undiluted gas is irrespirable, and unless due caution be used its irritating properties will outweigh any good due to its disinfecting and stimulating powers. It may be evolved in proper dilution for inhalation by mixing one or two drachms of chlorine-water with a couple of ounces of hot water, and placing the vessel in a hot bath or over a flame; or it may be diffused through the air of an apartment by allowing a saturated solution of chlorinated lime to drip upon diluted sulphuric acid in Corrigan's apparatus or some more modern generator.

Shurly makes use of one of two methods: when there is laryngeal ulceration he diffuses a spray of (saturated) sodium chloride solution

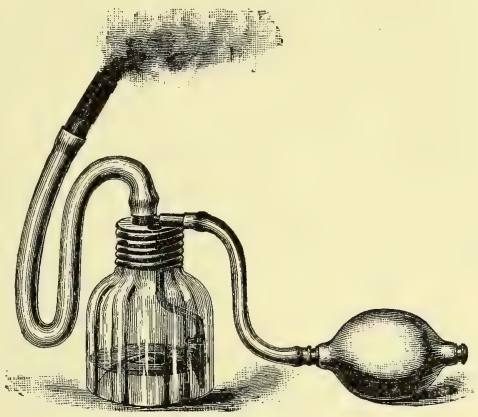
[1] *Journ. Amer. Med. Ass'n*, Feb. 21, 1891; *Therap. Gaz.*, Apr. 15, 1891.

through a small room, in which chlorine gas is afterward evolved in the proportion of from 1 in 4000 to 1 in 20,000 of the air-contents.[1] The diffusion of salt and gas being complete, the patient enters and remains at first ten minutes, afterward half an hour or longer, in the medicated atmosphere; the spray of sodium chloride being continued. The patient is directed to keep the mouth closed and breathe through the nose.

When there is no ulceration, sodium-chloride solution and recent chlorine-water are mixed in a suitable inhaler.

I have found it perfectly feasible to use, even in cases of ulceration, chlorinated water and sodium-chloride solution in the Oliver nebulizer (Fig. 163), the relative quantities being found by experiment for each patient. When the chlorine-water is very recent, one part to two of sodium-chloride solution—or with less recent chlorine-water equal parts—will represent the average. From half an ounce to two ounces of the mixed solutions may be vaporized at a sitting, and there may be from one to three or more sittings a day.

FIG. 163.



Oliver's Nebulizer.

Evans's and other inhalers, constructed on the principle of Oliver's—that, namely, of producing a spray with Bergsson's or Richardson's tubes, and breaking this up into a veritable nebula by impact against the wall of the containing vessel or other convenient obstacle—may likewise be employed. The inhalation of chlorine in this way helps to control suppuration in phthisical cavities, and in some cases apparently causes the disappearance of bacilli from the sputum. "Usually it is better for the patient to inhale soon after a thorough expectoration, and not too near meal-times, as not infrequently there is a striking effect upon the stomach, as shown by nausea and vomiting." In one case I had to abandon the inhalations on this account.

Chloroform may be used to mitigate the sharpness of chlorine vapors, and has a certain utility of its own as an antiseptic, apart

[1] "In a small room or compartment of about 550 cubic feet place from a half drachm to six drachms of chlorinated lime, spread out in a saucer or shallow glass, and to this add slowly from one to three drachms of dilute hydrochloric acid, stirring with a wooden spoon or spatula. One-half drachm is the commencing amount, and more should be added each day until about three or four drachms are used."

from its anæsthetic quality. In combination with other agents, I use it very often on the Yeo respirator and in Oliver's nebulizer.

Fluorine, the remaining halogen, is at present represented by *hydrofluoric acid*.[1] Inhalations of the vapor of this substance have been extravagantly lauded and as extravagantly denounced. From the point of view here taken, its power or its inability to kill tubercle bacilli is a matter of indifference, though Trudeau's observations[2] are convincing as to its possession of this power. If it help to control suppuration and to correct the conditions that permit the bacilli to live in the human tissues, that is all we can ask. It was in glass-factories that the beneficial influence of this gas on tuberculous workmen was noted. Hastings[3] gave it in solution internally, in minute doses ($\frac{1}{48}$ℳ to $\frac{1}{12}$ℳ), and in combination with oxalic acid. Bastien, in 1862, employed it by inhalation, but its repute in recent years is due to Chevy,[4] Seiler,[5] and Garcin,[6] whose good results, communicated to the French Academy of Medicine, have been confirmed by the report of Herard[7] and his commission.

Garcin places his patients for an hour daily in a cabinet of six cubic metres' capacity, into which he pumps air previously saturated with the gas by passing through a solution of 1 part of hydrofluoric acid to three of distilled water contained in a rubber bottle. According to the susceptibilities of the patient, from 20 to 30 litres of the fluorized air is mixed with each cubic metre of the air of the cabinet. Trudeau,[8] having made as air-tight as possible a small room in which the patient sat, placed a lead crucible containing from one to two teaspoonfuls of the acid in a tin vessel holding hot water. Under this an alcohol lamp was kept burning. The amount of vapor evolved will depend on the heat applied, which can be regulated according to the patient's tolerance. Trudeau remarks that "the inhalations when properly diluted have produced no bad effect in any case, and are not contraindicated even when a tendency to hæmoptysis exists."

Valenzuela[9] has used hydrofluoric acid in connection with inhalations of suboxygenated air (p. 1004). In some cases it seemed to hasten the disappearance of cough and expectoration. In others it provoked hæmoptysis.

Raimondi[10] employed inhalations of hydrofluoric acid by placing the patient for an hour daily, for a period averaging from 60 to 80 days, in a cabinet of three cubic metres' capacity, into which passed per minute

[1] It is quite possible that *ethyl-fluoride*, *methyl-fluoride*, *amyl-fluoride*, and *fluoroform* may be found available and useful.

[2] *Med. Record*, May 15, 1888.

[3] *Lancet*, 1855, i. p. 31

[4] *Thèse de Paris*, 1885.

[5] *Bull. de l'Acad. de Méd.*, Paris, 1885.

[6] *Ibid.*, 1887, serie ii. t. xviii. p. 419.

[7] *Ibid.*, p. 626.

[8] *Loc. cit.*

[9] *Op. cit.*, p. 661.

[10] *C. R. Cong. p. l'Étude de la Tub.*, t. i. p. 662.

about 125 litres of air charged with the vapor of hydrofluoric acid, by passing it through solutions of definite strength. Children and young persons seem to be especially amenable to the influence of the vapor. In older persons the effect is less rapid, some four months being required to produce definite results. According to Moreau and Cochez,[1] hydrofluoric acid stimulates appetite and modifies the nature of the bronchial secretions, probably destroying microbes and their infectious products. Like Lépine, they regard it as an eupeptic. Other observers have reported in direct contradiction to those cited.

On the whole, the various reports seem to indicate that, while not a specific and while often useless, hydrofluoric acid deserves a permanent place among agents that may be used to fight the tuberculous process. The guarded endorsement of so accurate an observer as Trudeau is worth more than a volume of ordinary loose assertions.

Balsams, Resins, Essential Oils, Camphors, and Allied Substances.

The custom of sending consumptive patients to regions where they might breathe the balsamic atmosphere produced by the vegetation of aromatic plants or the resinous emanations of the coniferæ is of great antiquity, and observations on the health of lumbermen, charcoal-burners, and those employed in the manufacture of tar, pitch, turpentine, rosin, and the like, or in occupations wherein quantities of these substances are handled, are frequent. It is not surprising, therefore, that from early times attempts should have been made to produce artificial atmospheres saturated with the fragrant or health-giving vapors, or to utilize these vapors by direct inhalations. Allusions to the practice are found in the Talmud, and it is attributed to Galen, Asclepiades, and Dioscorides. "Bennett of London, in the middle of the seventeenth century, employed artificial balsamic atmospheres by fumigations of *frankincense*, *styrax*, *ammoniacum*, and *turpentine*, with *coltsfoot*, *cinnamon*, and the like, in powder or made into troches and burned upon coals. He also employed the vapors evolved by pouring boiling water upon various mixtures of herbs. Trousseau and Pidoux preferred to throw some of the balsam upon live coals, ... because by this method the apartment becomes filled with the vapor and the patient can remain for whole days in an atmosphere thus impregnated." *Benzoin*, *balsam of Tolu*, and *balsam of Peru* were the drugs employed.

Balsam of Tolu or *balsam of Peru* may be inhaled in ethereal solution after the method of Rozière, 20 parts of the balsam being dissolved in 60 of ether and placed in a wide-mouthed vial, which the patient holds uncorked to his nose for two or three minutes every half hour.

[1] *Études expér. et clin. sur la Tub.*, tome ii. f. i. p. 271, *seq.*, Paris, 1888.

Benzoic acid, *ammonium benzoate*, and *sodium benzoate* may be used by spray in any convenient apparatus. Sodium benzoate in large quantities was urged by Rokitansky as a specific in tuberculosis. *Benzoin* in the form of the compound tincture may be inhaled from steaming water or used on the sponge of Yeo's or other respirator. Boiling water may be poured on one or two drachms of any of the balsams in an ordinary inhaler. Coxe used *balsam of copaiba* in this way. According to Polak, who was physician to the Shah of Persia, the Persians mix the medicinal substance with smoking tobacco in moistened masses, which are inserted into the plaster bowl of the narghilé and covered with burning coals. I consider the method excellent, but the tobacco an objectionable ingredient. Petrescu [1] uses the water-bowl of the narghilé for an inhaler, inserting into the pipe end sterilized cotton to filter the air, and placing in the water a solution of volatile antiseptics.

According to Ireland,[2] the air of pine forests contains large quantities of ozone produced by the reaction of light and air with the *terebinthinate* emanations; and Loomis [3] has more recently called attention to this fact, or rather to the presence in the atmosphere of hydrogen dioxide, as explanatory of the great benefit derived by consumptives from residence in pine-bearing regions. Ireland suggested that by living in a room or conservatory filled with pine saplings patients might derive similar benefit, which he attributed to the action of ozone or antozone on the blood.

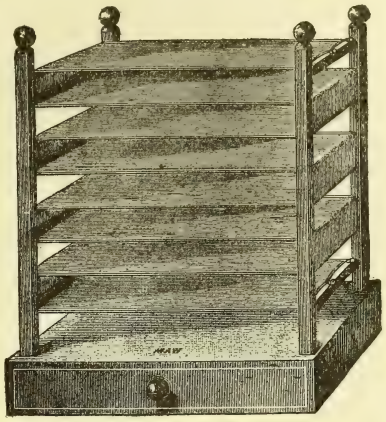
J. Solis-Cohen has seen much good follow the practical application of these suggestions. Fresh pine boughs may from time to time be placed in the patient's bed-room and sitting-room, or the attempt be made to grow pine-saplings in the house. While they retain their vitality a certain amount of vapor is given off.

Turpentine may be diffused through the air of the room in any convenient way. The longer it is exposed to air and light the more powerful is it. Turpentine may be sprinkled on the floor of the patient's room, or shallow pans containing it may be placed upon the hearth or elsewhere, so that the contents will be subjected to a gentle heat and continuous evaporation take place; or if it be necessary to use greater heat the oil may be thrown upon water which is brought to something less than the steaming point. Apparatus of various kinds have been devised to keep up a constant draught of air in a receptacle containing volatile medicaments. One of the most ingenious of these is a fan turned by clock-work, causing a current of air to play upon a rope of lampwick suspended from a porcelain dish containing the desired

[1] Cited in *Medical and Surgical Rep.*, June 28, 1889.
[2] *Edinb. Med. Journ.*, Feb., 1864.
[3] "Trans. American Climatological Assn.," *Med. News*, July 23, 1887.

medicament. Hassall[1] has devised a compact, portable "chamber inhaler" (Fig. 164) consisting of a long cotton fabric so woven as to afford a very large extent of surface for evaporation, which is spread out in several layers, one above another, by means of an arrangement consisting of a double series of rails attached to a box and lifting out and in. The smaller size is 8 × 11 inches. The cloth is saturated with a solution of carbolic acid, or whatever drug be employed, which volatilizes at the temperature of the apartment. A little machine that has but recently been put upon the market consists of a disk of metal suspended within a vessel which contains an alcoholic extract of the desired medicinal substance. The extract being fired, the flame is immediately extinguished by placing the lid upon the vase, but the disk has been warmed, and by the reaction between it and the alcohol vapor it continues to alternately glow and become dull, keeping up sufficient warmth within the small vessel to secure gradual volatilization of the entire quantity of essence.

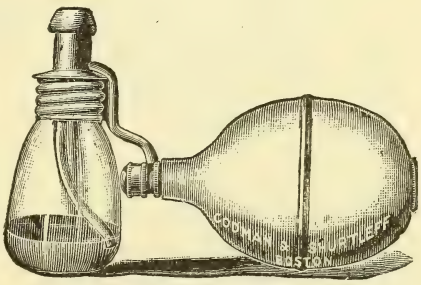
Fig. 164.



"Chamber Inhaler" (Hassall).

Terebene, eucalyptol, various *oils of pine,* of which the best are those of the Scotch fir tree (*Pinum Sylvestris*) and of the mountain-pine (*Pinum pumêlion*), may be used with or instead of turpentine. Any of these agents may likewise be employed by direct inhalation, as from the surface of steaming water or the sponge of the Yeo respirator; or a sponge saturated with the oil may be enclosed in a bag of cheese-cloth suspended like a locket about the patient's neck. With children this last is a useful expedient. Turpentine liniments are often applied to the chest, and these give off some vapor for inhalation. I frequently use terebene or eucalyptol on the sponge in my compressed-air apparatus, or pass the air through a Wolff bottle containing one of these agents floating on the water. A favorite formula

Fig. 165.



"Vaseline Atomizer."

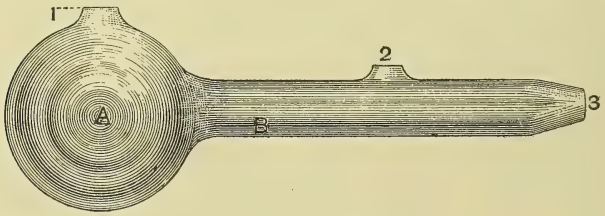
[1] *Inhalation Treatment,* London, 1885, p. 63, *seq.*

for use with the Yeo respirator is *terebene, eucalyptol, ethyl iodide,* and *alcohol* or *chloroform,* equal parts. Lewin places a few drops of the drug to be used on a piece of cotton in the bowl of a small smoking-pipe, through which the patient inspires for several hours at a time. Solutions of *thymol* or *menthol* in alcohol or oil (5 to 20 per cent.) may be employed in any of the methods mentioned. Oily solutions may be used for direct inhalation by nebulization, especially in the Oliver vaporizer. Messrs. Codman & Shurtleff's "vaseline atomizer" (Fig. 165) is a convenient instrument for administering inhalations of menthol, say a 10 per cent. solution in benzoinol. Crystals of menthol may be placed in a little covered tube like a lead-pencil case or an imitation cigar, that can be carried in the pocket and used when desired.

G. A. Evans[1] has so modified Pomeroy's little pocket inhaler that it may be utilized "to secure the simultaneous operation of voluntary deep breathing through a small orifice in conjunction with local medication of the air-passages." It thus makes a cheap, cleanly, and convenient instrument (Fig. 166) for use with terebene, creasote, solutions of thymol and menthol, ethyl iodide, and similar substances. Gentle heat and alcohol will rid the sponge of menthol when desired, and chloroform will wash out the other solutions mentioned.

"It should be used in the following manner: Medicate the sponge in the bowl (A) of the inhaler, place the open end of the stem (B) well between the lips; close the stem opening (*2*) with the index finger of the right hand and inspire deeply, lengthening the pause at the end of the inspiratory act to facilitate intra-pulmonary gaseous diffusion; cover the opening (*1*) in the bowl (A) with the index finger of the left

Fig. 166.



Evans's Pocket Inhaler.

Half size. Diameter of bowl, *A*, 2 inches; cross diameter of stem, *B*, $\frac{5}{8}$ inch; openings in bowl and stems *1*, *2*, *3*, $\frac{5}{16}$ inch; the bowl, *A*, is almost filled with soft fine sponge.

hand; uncover the opening (*2*) and empty the lungs by blowing through the openings (*3* and *2*) of the stem.

"Respiration should be carried on in this manner at the rate of about ten a minute, and continued until the desired effects have been secured."

[1] *N. Y. Med. Journ.,* April 18, 1891.

In addition to the agents mentioned, oils of *aniseed, caraway, chamomile, cedar, clove, cubeb, hops, juniper, marjoram, mint, sage,* and the like, and vapors of *camphor* and similar substances, have been employed. The indications for these various agents are very similar. I have used nearly all, and used them by nearly every method. Those I have settled upon for constant use are, in what I conceive to be the order of merit, *terebene* (or *turpentine*), *menthol, eucalyptol, thymol.* With the possible exception of turpentine (as a type of its group), they have not seemed to me to have the slightest influence over tuberculous processes; but in collateral catarrhal inflammations and ulcerations of larynx, trachea, and bronchi, they are of the greatest possible benefit, promoting expectoration, cleansing the mucous membrane of dead and dying epithelium, and stimulating the production of a healthy covering. They likewise assist in controlling the putrefaction processes that attend softening and excavation, and—if we may reason from the improvement in auscultation phenomena—in producing a healthy surface on the lining of cavities. I consider them indispensable in the management of cases that present any of the conditions named.

"*Vapors of tar,* made warm and diluted with oil of turpentine," were used by Edward Jenner,[1] his object being to kill thereby the parasite to which he attributed the disease, and which he supposed to be akin to, if not identical with, that of hydatids. He compared tubercles to the oak-apple or gall-nut, or the mossy excrescence that springs from the wild rose or sweetbrier, these being due to "insect-irritation."

Tar vapor was likewise recommended by Rush, whose method was to boil together equal parts of tar, bran, and water. Beddoes[2] relates a case in which exposure to the emanations of tar in a warehouse was of great benefit. Crichton[3] dissolved a quantity of tar in water, and added potassium carbonate to neutralize the "pyroligneous acid," slowly boiling the mixture over a spirit lamp, taking care that it boiled and did not burn. Morton and George B. Wood are among the Philadelphians that, following the lead of Rush, found considerable benefit from inhalations of tar. J. Solis-Cohen says: "I have frequently seen benefit from the vapors of tar in cases of advanced phthisis. In recent inflammations and in the hectic fever of phthisis its use requires caution, as it is said to induce congestion, and may thus give rise to hæmorrhage or severe inflammation." His method is to mix prepared tar with water until it is soft, and place it in an iron saucepan nearly filled with water, over which is fitted a tin cover terminating in an elbow of piping. The pot is heated upon the fire or over a gas flame or alcohol lamp, and the

[1] Letter to Beddoes—*Factitious Airs,* 3d ed., Part ii. Addenda, p. 1.

[2] *Factitious Airs.*

[3] *An Account of Some Experiments made with the Vapour of Boiling Tar, etc.,* Edinburgh, 1817.

vapors are diffused through the room. For direct inhalation of tar an apparatus at one time much used in Germantown consists of a tin vessel of about a pint capacity for holding water, into which tightly fits a shorter tin cup for receiving the tar.. The latter is tightly covered with a lid pierced with air-holes and fitted with a delivery-tube. The vapor is evolved by heat. Delmis,[1] finding inhalation of tar fumes impracticable, used pastilles of tar, which were allowed to dissolve in the mouth. He believed that the emanations would thus be inhaled.

Of recent years tar has been almost entirely superseded by *creasote*, which is more convenient and equally efficacious; except that it is not so stimulating as is the tar.

Creasote may be used on the Yeo respirator in combination with other drugs already mentioned or alone. *Chloroform* should, I think, be always added. *Terebene*, *creasote*, and *spirit of chloroform*, equal parts, is a favorite combination. It may be inhaled from warm water, or preferably from Oliver's apparatus, in the proportion of from 3 to 20 drops to 7 drachms of water and 1 drachm of glycerin. When not readily tolerated *conium* may be added. The addition of glycerin to solutions used in Oliver's apparatus, or the similar instruments of Evans and others, is a useful expedient that we owe to Evans.[2] It keeps the spray suspended much longer than a simple watery solution. Various combinations of creasote, terebene, eucalyptol, and the like are sometimes used. Germain Sée[3] slowly introduces into the pneumatic chamber compressed air passed through creasote and eucalyptol. The medicated air is delivered at the rate of twenty cubic metres per hour for a chamber of five cubic metres capacity. The pressure is thus gradually raised to ½ atmosphere. The sitting lasts from two to three hours daily.

Naphtha was used by Crichton, and more recently by Korshenewski.[4] The latter noted the recovery of consumptives employed in the naphtha-works at Baku. *Pyroligneous acid* was said by Chapman to cause healing of ulcerations of nose and throat. Hue and Bruère[5] observed a consumptive improve through inhalations of *picric acid* used in his work, and treated a number of patients by inhalation of the vapor of boiling solutions of the drug. Hastings[6] used "naphtha," probably an impure mixture of *creasote*, *methyl alcohol*, and *acetone*, by inhalation as well as internally. *Carbolic acid* may be used in the same way as creasote, except upon the Yeo respirator, for which it is too irritating. It may be exposed by the bedside in shallow dishes,

[1] *Gaz. des Hôp.*, 1883, No. 137, cited by Wesener.

[2] *N. Y. Med. Journ.*, 1886, xliii. p. 264.

[3] A recent communication to the French Academy of Medicine, cited *Lancet*, May 23, 1891.

[4] *Wratsch.*, 1887, No. 17, cited by Wesener.

[5] *Gaz. hebdom. de Méd. et de Chir.*, 1887, No. 19, p. 312, cited by Wesener.

[6] *Infra cit.*

evaporated from towels or from Hassall's apparatus, or sprayed about the room to impregnate the atmosphere. It may be used in combination with *iodine* and *conium* from the vapor of hot water. Jaccoud most enthusiastically extols its use by steam-nebulization[1] for effect upon the contents of cavities. He usually employs two ounces of a 2 per cent. solution at each of three or four sittings daily. Sometimes he begins with a ½ per cent. solution, and sometimes increases the strength to 4 per cent. It is not resorted to during the active stage of softening, and is discontinued if it give rise to persistent unpleasant symptoms. I do not use carbolic acid, as I prefer creasote; and I do not approve of steam-nebulization in chronic inflammations of the respiratory passages, phthisical or non-phthisical. For mild continuous effect the respirator, for decided effect the Oliver vaporizer, is the best instrument to employ. *Anilin* was lauded by Kremjanski.[2]

Inhalation of creasote is indicated at any stage in any variety of phthisis, but more especially for its influence upon catarrhal processes and for control of ulceration, suppuration, and putrefaction, thus preventing or checking sapræmia or septicæmia and concomitant fever. Thus its combination with *terebene*, *ethyl iodide*, and *chloroform* fulfils nearly all the indications presented in the ordinary form of phthisis, including sedation of unproductive cough. For the latter purpose various other agents have likewise been employed, of which two only need here detain us—*ether* and *conium*. Pearson communicated to Beddoes[3] a number of cases in which marked palliative improvement resulted from inhalation of the vapor of ether in which cicuta-leaves had been steeped. Half an ounce of the powdered leaves was kept for a week in an ounce of ether, and the vapor of a tea-spoonful or two of the impregnated fluid inhaled at a time, three times a day or oftener. The effect was to subdue hectic, check perspiration, relieve dyspnœa, deodorize the sputa, and facilitate expectoration. Ether may likewise be impregnated with *camphor*, *musk*, *opium*, and other stimulants or sedatives. Whether the cicuta of Pearson was what we now call by that name or what we term conium, I do not know. The effect doubtless depends upon very similar principles, and *conium* is what we now use; the indication being either to mitigate pungent inhalations or to check cough by its own sedative properties. Stokes, who opposed almost all other inhalations, found conium useful. A few drops (5 to 20) of tincture or fluid extract may be added to the steaming water used to volatilize iodine, creasote, or other medicaments, or in the proportion of 3 to 5 drops to the ounce of water, be employed by spray. Æthereal fluid extract, properly diluted, may be cautiously employed for direct inhalation. The

[1] *Op. cit.*, p. 196.

[2] *St. Petersb. med. Woch.*, 1887, No. 5, p. 42.

[3] *Op. cit.*, p. 171.

solid extract may be used with warm water, twelve or fifteen grains being diffused in a proper inhaling apparatus. It is always best to add a small quantity of some alkali, so that the alkaloid may be released from combination and become volatilized. Its odor will indicate its presence.

Germicide Inhalations and Insufflations.

There are a number of substances from time to time proposed for local influence upon the respiratory tract, the use of which has not originated in an imitation of climatic or industrial effects, but may be here considered for convenience.

Those that have been urged or revived since Koch's discovery, are principally germicidal[1] agents, and are directed against the bacillus. Recalling the location of lesions containing bacilli, any one at all familiar with the penetrating power of sprays and vapors under the usual physical conditions will know how fallacious is this notion. Some of these agents may, however, be useful in the same manner as those previously discussed, in disinfecting the air-tract; or, if absorbed into the blood in sufficient quantity, by their constitutional effect. I do not advise any of them, though they may sometimes be used advantageously, provided the use be with definite purpose under proper indications.

Sodium benzoate, recommended in 1879 by Rokitansky,[2] was directed against bacteria known and unknown. He administered 1 gramme (15 grains) daily for each kilogramme (about 2 pounds) of body-weight; that is, about 2 ounces in most cases. A 5 per cent. solution was made, and the daily quantity divided into two portions, each of which was nebulized and inhaled at one sitting. This, according to Jaccoud, would require the patient to spend five hours daily in inhalation. The latter modified the practice by dissolving an ounce of the salt in 6 ounces of water and nebulizing this by steam spray in the course of forty-five minutes. The spray was arrested whenever an attack of coughing supervened, and the patient remained in the medicated atmosphere for an hour after the direct inhalation was concluded. Jaccoud was not able to confirm Rokitansky's reported results. *Ammonium benzoate* and *benzoic acid* have been used similarly.

Schoull[3] advocates nebulizations of warm solutions of *boric acid* (15 per cent.). He claims to thus produce a marked and rapid diminution of cough and expectoration and a favorable influence upon physical signs. Stronger solutions obstruct the nebulizer. Boric acid is dissolved at 80° C. (176° F.), and remains in solution at 55° C. (131° F.).

[1] Parasiticidal inhalations are not at all novel, however. They were used by Edward Jenner.

[2] Cited by Jaccoud, *op. cit.*, 214.

[3] *Gaz. hebdom.*, Nov. 25, 1887.

Glycerin retards the spray. In order to prevent deposition of the acid, the tubes must be warmed before being placed in the solution.

Solution of *mercuric chloride* in spray has been employed by many observers. It is useless.

Mercuric-potassic Iodide.—Miquel and Rueff[1] used a spray of a solution of mercuric iodide (1 part) and potassium iodide (1 part) in water (1000 parts), at first once daily, and when tolerance was established twice daily. If necessary the solution was weakened. The treatment, it is gravely said, "can be prolonged for one year without doing harm." Lange[2] used vapors of *mercury* and *iodine*.

Powders.

James Watt—who will be honored for his contributions to medical practice when the mighty force he harnessed for the service of man shall be superseded and our modern engines shall be as obsolete as that of Hero—thought that possibly some of the benefit from the gases administered by Beddoes might be due to particles of *metallic oxides* (iron, zinc, etc.) or of *charcoal* carried over; and fortified himself on the physical side by citing post-mortem examinations of the lungs of miners, steel-grinders, and others exposed to dusty atmospheres.[3]

Pick,[4] basing the practice on the freedom from phthisis of the North Bohemian miners, tries to induce an artificial anthracosis by inhalations of *soot*, *lampblack*, and "*fuligo depurata*." Morgan[5] calls attention to the immunity from phthisis of Scotch crofters, whose cottages ("bothies") are filled with *peat-smoke*.

Erasmus Darwin[6] constructed a box in which powders were stirred up for inhalation by turning a cylinder studded with bristles, somewhat like the revolving broom of our street-cleaning machines. Those who have met the latter in action will not doubt the efficacy of his instrument. The powders he employed were *metallic oxides* (zinc, lead, iron) *charcoal*, and *Peruvian bark*. Trousseau and others have used tubes of glass, metal, or rubber, variously curved, through which powders are propelled by compressed air or the breath of the operator, or inspired by the patient closing his lips about the tube and taking a deep breath.

Various antiseptic, astringent, caustic, and sedative powders are used, chiefly for effect in the upper air-passages, as we shall detail hereafter, but occasionally for intra-pulmonary medication as well.

[1] Cited in *Med. News*, March 30, 1889.
[2] *Journal American Medical Ass'n.*, Oct. 5, 1889.
[3] Letter to Beddoes, *op. cit.*
[4] Cited in Vienna correspondence of *Medical Press*, Sept. 3, 1890.
[5] *British Med. Journ.*, May 23, 1885, p. 1039.
[6] Beddoes, *Factitious Airs*, p. 150.

To be effective for the latter purpose—which I have never attempted to carry out—some such machine as Darwin's or Fournier's is necessary; or the inspiratory current of compressed air from Waldenburg's or other apparatus can be made to carry powders by passing it through a vessel in which it keeps the powder stirred up; or the air of an inhalation-chamber can be kept laden with fine particles by deposition from spray or otherwise. *Iodoform, tannin, benzoic acid* and *benzoates, boric acid* and *borates,*[1] *calcium phosphate,*[2] and "*chaux hydraulique*"[3] are among the agents employed.

Prophylactic Medication.

Certain drugs and allied agents may be employed in prophylaxis or in the treatment of early stages of the developed disease, the management of which does not very greatly differ from that required in the attempt at prevention. No drug should be given without good reason therefor; and medication should be stopped as soon as possible. When, however, it is actually necessary to persist in a course of medication, no hesitation need be felt in doing so.

In prophylactic medicines two great divisions may be made: first, those whose object is to help bring about the healing of catarrhal lesions or other inflammatory conditions that might become the starting-point for overt or latent tuberculosis: and secondly those which aim to improve nutrition by enriching the blood; by assisting or stimulating digestion, alimentary or respiratory; by reinforcing nervous power; by promoting excretion; or by what must be loosely called "general tonic effect."

The treatment to be pursued in cases of catarrhal or other inflammations occuring in a hypotrophic subject is not very different from that pursued with other subjects, and must be guided by the special symptoms and indications. Still, a word or two must be said about a

[1] Canio, *Centralbl. f. d. med. Wiss.*, 1887, No. 41, p. 769.

[2] Loebinger, *N. Y. Med. Journ.*, Dec. 20, 1890.

[3] *The Dust of "Chaux hydraulique."*—According to Mougeont (*Cong. pour l'Étude de la T.*, t. 1, 689), those who work in factories of *chaux hydraulique* acquire an immunity against throat and bronchial affections, and, so they claim, against all forms of chest-trouble. Epistaxis, however, is a danger to which they are exposed. The unexpected recovery of a patient far advanced in phthisis who had gone to die in the house of his son, the latter being engaged in such a factory, led Mougeont to send thither another patient with decided tuberculosis of the larynx. Tolerance was slow of establishment, but when obtained the amelioration was so rapid that the patient insisted on passing his nights near the place. Mougeont proposes to gather a number of patients in an apartment where they can inhale the dust constantly. He does not know to which constituent the effect is due. The composition varies in different factories. One of the best known is—silica, 18.9; alumen and peroxide of iron, 10.5; lime, 59.7; magnesia, 0.7; alkaline salts, 0.1; water and carbonic acid, lost at red heat, 10.1.—Total, 100.

It is possible that heat has something to do with the effect, real or supposed, produced by this occupation.

few points requiring special care. Supporting measures are of the first importance, and no "cold" or "biliousness" is so slight that we can afford to neglect it. It is well to use *cod-liver oil* during convalescence at least from such attacks, and during an attack, acute or subacute as may be, to resort as far as possible to such antiseptics as *creasote* and *salol* for internal use, and *ammonium* preparations and the *terebinthinates* for administration either internally or by inhalation. *Antimonials* are advised, but I have not used them. *Quinine* should be used in all cases of pneumonia, broncho-pneumonia, or even of bronchitis, if it appear to be due to influenza. I had seen, even previous to the pandemic of 1889, many cases of phthisis that had apparently originated in neglected or unrecognized influenza,[1] and recently this experience has been increased.

In cases presenting symptoms or signs indicating severe, or extensive even if slight local inflammation, *counter-irritation* is highly advisable. Graves,[2] indeed, strongly recommended as preventive of phthisis in cases of marked hereditary tendency "the insertion of issues or setons in the chest before or after puberty," even in the absence of existing inflammation; and stated that he never treated a case of incipient phthisis without inserting at least two setons under the collar-bones.

Certain drugs seem to have decided influence over inflammatory processes. Among these are *salicin* and its derivatives, *mercurials* and *opium*. *Codeine sulphate* (gr. $\frac{1}{16}$ to gr. $\frac{1}{2}$, *p. r. n.*) sometimes seems to marvellously control inflammations of serous membranes. Graves[3] advocated the rapid mercurialization of robust subjects of the scrofulous diathesis who had "taken cold," whether symptoms of pneumonia or only of severe bronchitis presented. It is still good treatment for robust patients. A pill of *salol* (gr. ij to gr. iv), *terpin hydrate* (gr. ij to gr. iv), and *codeine sulphate* (gr. $\frac{1}{16}$ to gr. $\frac{1}{4}$), given every second to fourth hour according to circumstances, has proved of great service in my hands in the management of all varieties of inflammation of the respiratory apparatus and its appendages, but more especially in acute and subacute catarrhs of the laryngo-bronchial tract. Salol is also of service in pleurisy and in intestinal catarrh. In affections of the alimentary tract *turpentine* seems better than any of its derivatives.

In the medicinal treatment of enlarged glands in children—a subject more fully considered, however, in the article on Scrofulosis—*hydrated calcium chloride* (gr. iij to gr. v, in simple elixir or in glycerin and water three times or more daily, after food) has proved the most useful agent that I have by personal experience tested. Beddoes[4]

[1] "Some Practical Points in Connection with Catarrhal Fever," *Med and Surg. Rep.*, Oct. 29, 1887.

[2] *Clinical Lectures*, edited by Neligan, Dublin, 1864, p. 521. [3] *Op. cit.*, p. 525.

[4] *Observations on the Cure of Scrophula*, ed. Troy, 1803, p. 137.

added hydrochloric acid and infusion of calumbo to the "solution of muriate of lime" that he introduced into English practice, and from which he derived such good results. So soon as their presence is discovered these glands should be treated by external applications, preferably of ointments of *iodine* or of one of its salts (e. g. *mercuric iodide*), *iodoform-collodion* (10 per cent.), or *ichthyol* (20 to 50 per cent.), and the internal administration either of hydrated calcium chloride, as already suggested, or of *Donovan's solution*, or of *iodoform*, or of some other iodine preparation. *Iron iodide* has great repute. Recently I have used *barium iodide*—an old remedy—in a few cases with fairly satisfactory results. *Barium chloride*, likewise an old remedy, may sometimes be used alone or in combination, and has the advantage of an action upon the heart somewhat similar to that of digitalis. When syphilitic taint is known to exist, bold use must be made of *mercury* and of *potassium iodide;* and in some cases, even in the absence of such knowledge, the "therapeutic test" must be made. Cod-liver oil should be used during or immediately following a course of the iodide. If after fair and persistent trial of hygienic and medicinal measures, the glands do not yield, surgical intervention is required; for they may become later in life the starting-point of general infection. Other so-called strumous affections likewise require careful attention; and it is well to again emphasize the necessity for solicitude as to pleurisy or any obscure abdominal or thoracic affection. So-called "bronchial phthisis" is often overlooked.

Of drugs of the second group, while *iron* is sometimes indicated, more particularly in the somewhat small group of cases showing deficiency in red blood-cells, *arsenic* is more generally useful in the treatment of anæmic, scrofulous, and dyspeptic subjects. Jacobi[1] speaks highly of arsenic as an anti-tuberculous medicament. Of arsenical preparations I prefer Donovan's solution (*liquor arsenii et hydrargyri iodidi*) or *arsenic iodide* in pill-form; though *Fowler's solution*, *arsenious acid*, or other preparation may be employed. Of the solutions, small doses (2 to 5 minims for an adolescent, given after food, two or three times daily) will be sufficient, unless marked anæmia should require active treatment. Of the arsenic iodide, I give to an adolescent from $\frac{1}{30}$ grain to $\frac{1}{12}$ grain, with some bitter extract, after meals. Jaccoud uses *cinchona* preparations extensively.

The alimentary canal must be kept in a proper state of cleanliness and health. Dyspepsia, the so-called prephthisical dyspepsia, is one of the earliest signs of that condition of malnutrition which we look upon as the basis of the tuberculous diseases. The mucous membrane with its important glands being poorly nourished, its epithelium fails to mature, and is desquamated in an immature condition. This is not,

[1] Keating's *Cyclopædia*, Philada, 1889, vol. ii. p. 164, *seq.*

properly speaking, a catarrhal inflammation. It is not dependent upon supernutrition, but upon insufficient nutrition. It is a mild catarrhal necrosis. The products of desquamation mechanically interfere with digestion, and by their irritation set up further changes. Then, too, the gastric, intestinal, pancreatic, and hepatic secretions are imperfectly elaborated. The first indication for treatment of this condition is improvement of the nervous influence and blood-supply upon which the imperfect function depends. Chief of the medicinal agents upon which reliance can be placed is *arsenic*. For this special purpose it is preferably given in the form of Fowler's solution in doses of $\frac{1}{2}$ minim or more, properly diluted, immediately before meals. Advantage is sometimes derived from pushing it up to the point of tolerance, as in ordinary cases of anæmia. It is then to be given after meals. Hardly second to arsenic is *strychnine*. This may be given as strychnine sulphate or as tincture of nux vomica in doses equivalent (for an adult) to from $\frac{1}{80}$ grain to $\frac{1}{30}$ grain of strychnine sulphate, thrice daily. The diluted mineral acids, especially *diluted nitro-hydrochloric acid* (gtt. x to xx) and *diluted phosphoric acid* (gtt. xxx), are of considerable service in the same connection. They are to be given after meals.

While endeavoring to improve the blood and nerves by these agents, we also endeavor to act locally upon the mucous membrane by copious potations of *hot water*. Hot water mechanically cleanses the alimentary canal and to some extent stimulates the production of a healthier epithelium. From half a pint to a pint of hot water should be drunk half an hour to an hour before meals. Sometimes this alone is not sufficient, and "*lavage*" must be resorted to. Hot lemonade is sometimes more agreeable than hot water, and very often serves an equally good purpose. Digestion may be aided for a time by the administration of *pepsin* or *pancreatin*,[1] according as gastric or intestinal digestion seems at fault. As a rule, however, I am averse to the use of these agents. It is better to improve natural digestion if possible. *Predigested foods*, as already mentioned, find here another indication. *Ammonium chloride* (gr. xv) before meals, or *turpentine* in minute doses (1 to 3 minims in emulsion) given after meals, from time to time for short periods, influences beneficially the alimentary mucous membrane; the former agent being more useful in gastric catarrh, the latter in catarrh of the intestinal canal. Small doses of *creasote*, from $\frac{1}{2}$ minim to 1 minim, three times a day after meals, as has been especially pointed out by J. Solis-Cohen, are of the greatest utility in this connection. When fermentative conditions exist in the stomach or in the intestine, the dose of creasote may be increased to 2 minims. This is

[1] Dobell, believing tuberculosis to be due to the deficient assimilation of fat, depending on pancreatic disease, advocated pancreatic emulsions of various kinds, not only in this condition, but as a specific against phthisis.

a different use of creasote from that to which we shall refer later among the so-called specific medications. *Calcium sulphide*, when not too irritating to the stomach, plays a useful part in the treatment of fermentative dyspepsia. I usually give it in pill (gr. $\frac{1}{8}$—*q. 3 h.*) after a little milk or other bland fluid has been swallowed. Natural *sulphur-waters* or artificial sulphur and carbonic-acid waters, as recommended by Garnet[1] a century ago, and more recently by H. C. Wood,[2] are sometimes better tolerated than the calcium salt. *Salol*, in doses not exceeding 5 grains three or four times a day, may be occasionally employed with advantage, especially when there is a tendency to diarrhœa.

Hydrogen dioxide, dissolved in ether, glycerin, or water, may be given, sufficiently diluted, before meals, in doses equivalent to from 2 to 4 tea-spoonfuls of a 10-vol. aqueous solution for an adult, or proportionately for a child. This agent is usefully combined as a general tonic with *syrup of phosphate of iron*, as advised by B. W. Richardson,[3] to whom, indeed, we owe all its therapeutic uses. But the use here spoken of is as a local stimulant to the gastric mucous membrane and a corrective of local paraplasia and perverted zymosis. It will also be absorbed, thus increasing oxygenation and consequently elimination, assimilation, and appetite. An occasional effect of this agent that I have never seen described is slowing and strengthening of the pulse, and I have substituted it at times for digitalis in the treatment of the hypotrophic and the phthisical.

Gold and sodium chloride (gr. $\frac{1}{12}$ to gr. $\frac{1}{8}$) is a useful analeptic and nervine. *Mercuric chloride* in small doses (gr. $\frac{1}{100}$) for limited periods is useful in promoting destructive metabolism as a preliminary to reconstruction. When there is actual deficiency of red blood-cells, a useful combination is some such formula as that of Albert H. Smith, wherein *mercuric chloride*, *arsenic chloride*, and *tincture of ferric chloride* are dissolved with the aid of diluted hydrochloric acid. *Tincture of ferric chloride* (gtt. x–xv), with *diluted phosphoric acid* (gtt. xxx), in simple elixir and water, or, better, Parrish's *compound syrup of phosphate of iron*, will prove useful under the same circumstances. *Manganese* was strongly recommended by Horace Green.[4] The preparation he pre-

[1] "Letter to Dr. Beddoes," *Factitious Airs*, Part 1, 3d ed., p. 120.

[2] *Therap. Gaz.*, April 15, 1887.

[3] The following formula for *oxygenated syrup of superphosphate of iron* is given in the *Asclepiad*, 1887, p. 170: Syrup of superphosphate of iron, solution of hydrogen peroxide (10 vol.), pure glycerin, of each 1 fluidounce. Dose for an adult, from one to two fluidrachms, in three ounces of water, two or three times a day.

[4] *Op. cit.*, pp. 334 et 339. I copy a good formula:

℞. Manganesii phosphatis,	℥jss;
Ferri phosphatis,	℥iij;
Tr. calumbæ,	f℥ij;
Syr. tolutan.,	f℥iv;
Ess. gaultheriæ,	fʒj.—M.

Dose, one tea-spoonful in water after meals.

ferred was the *phosphate*, though he sometimes resorted to the *malate* as being more soluble.

The *hypophosphites of calcium and sodium* are of service as general tonics. The various wonderfully complex proprietary hypophosphites are far less useful. Except, as already mentioned, in convalescence from "colds" and the like, I have not seen any particular necessity for the use of cod-liver oil at this period, unless there is failure to digest fats. Even then, I should first try the effect of Hoffman's *compound spirits of ether* (fʒj, with meals), and some of the preparations of *pancreatic ferment* and *bile*.

Constipation should be prevented by regularity of habit, by diet, and by exercise. When these do not suffice, *massage* of the abdomen may be made, or a *tonic laxative pill*—say extract of nux vomica (gr. $\frac{1}{6}$) or extract of ignatia (gr. ss) with extract of hyoscyamus (gr. ss) or extract of belladonna (gr. $\frac{1}{12}$ to $\frac{1}{6}$) and resin of podophyllum (gr. $\frac{1}{8}$ to $\frac{1}{4}$) or resin of euonymus (gr. j–ij), or some similar combination—may be given from time to time once, twice, or thrice a day as needed, for several days or weeks. For temporary purposes, an *enema*, or a *mercurial* or *saline purge*, or one or two *compound rhubarb pills*, will answer better.

The urine should be measured and examined from time to time. The *water* prescribed will probably keep up its quantity, and *exercise* will secure free elimination of the products of retrograde metamorphosis. If, however, the urine should be scanty or qualitatively imperfect, measures appropriate to the condition must be instituted. When there is manifestly feeble circulation, or when defective assimilation seems due to the stagnation of the blood-current or to its imperfect penetration, *amyl nitrite* (gtt. ij–v in glycerin and alcohol), or *trinitrin* (gtt. $\frac{1}{100}$ to $\frac{5}{100}$ *t. i. d.*), with or without the conjoined use of *sparteine sulphate* (gr. $\frac{1}{2}$–gr. ij, *t. i. d.*) or of *digitalis* (gr. $\frac{1}{8}$–i, *t. i. d.*), is indicated to secure relaxation of capillaries with increased exposure of blood to pulmonary aëration and increased passage of nutrient liquor into the lymph-spaces; thus simulating to some extent the circulatory effects of altitude. The use of digitalis for the improvement of pulmonary and general circulation in the phthisical has the endorsement of so experienced and accurate an observer as Jacobi.[1] The same measures are indicated when recurring cough or slight hæmoptysis, associated with visible congestion of the upper air-passages (pharynx and larynx), even in the absence of abnormal percussion or auscultation phenomena, rouse the suspicion of imperfect or perverted circulation in the lungs. No matter how mild the condition may be as contrasted, for example, with the phenomena of pneumonia, it is well to remember the words of the great clinician of Dublin:[2]

[1] *N. Y. Med. Journ.*, April 24, 1886, p. 477.

[2] Graves, *op. cit.*, p. 517.

"Whatever increases the stagnation of blood or the engorgement of the lung, brings on a state of that fluid in which there is both detention and imperfect aëration—circumstances which are apt to produce not the nutrition of the organ in which they occur, but the formation of morbid depositions; and this appears to be the reason why inflammation and engorgement occasion tubercular development."

Under these same conditions, too, the use of *cod-liver oil* may be advisable, as it is in many cases of further advanced disease. The practice has the enthusiastic recommendation not only of Bennett, who introduced it, but of C. J. B. Williams and of Jaccoud, men entitled to speak *ex cathedra*. It is, too, the practice of the majority of physicians in America, from DaCosta to the recent graduate. I must confess that I do not share the common opinion as to the special virtues of this oil in phthisis. As a readily-absorbable and assimilable fat it has an indisputable food-value, but I have not found it in any, however limited sense, a specific against tuberculosis.

When there is difficulty in feeding the patient, or when a medicine has to be prescribed in order to have hygienic directions carried out, the popular estimate of cod-liver oil enables us to make good use of it. Williams points out that in order to get the best results from the oil carbonaceous foods must be interdicted, but, as previously said, I prefer the food. Recently I have been using *morrhuol* (gtt. v–xx in capsules, *t. i. d.*) principally as a vehicle for creasote, but also alone; and, to my great surprise, it does seem to have valuable medicinal properties; most probably as an aid to digestion.

Treatment of Tuberculous Lesions, Toxæmia, and Special Symptoms.

With the exception of certain inhalations, the measures hitherto considered, whether with exclusive reference to prophylaxis or with incidental reference to the management of patients in whom tuberculous lesions are manifest, have had for their principal object reinforcement of the vital energy. A subsidiary object that has received some attention has been protection against the exciting causes of disease, including not only possible infection with tuberculous products, but also the catarrhal or inflammatory conditions that permit such infection to occur more readily. Connected with this has been the treatment *secundum artem* of scrofulous glands or other possible sources of auto-infection, especially dangerous as excitants of tuberculous meningitis or other variety of acute disseminated tuberculosis; and it has been advised that when after reasonable trial other measures have failed, ignipuncture, excision, or other approved surgical procedure for radical destruction and removal of the caseous focus should be done. The opinion has also been expressed that in a hypotrophic subject

wounds, inflammation, or wear and tear may, by reason of imperfect reparative force, give rise to the initial histologic tubercle even in the absence of a specific virus; thus affording an additional indication for avoidance of the danger involved. Two words, then, will summarize all that precedes: they are, PROTECTION—INVIGORATION.

Invigoration is the more important. I know of no *radical treatment* but this. It must further have become evident to the attentive reader that whereas systematization of material and consecutiveness of discussion might have been facilitated by entirely separating the subject of prevention from that of treatment, yet this method would have involved the emphasizing of an artificial distinction that I conceive ought to be obliterated. For it has been recognized by the greatest teachers of all ages that the *prophylaxis* and the *cure* of tuberculosis depend upon identical principles, and the measures best adapted to effect either end are largely the same. In other words, prophylaxis is cure, and the only cure is prophylaxis. It is one, but its power is less the longer it is delayed. Therefore as time progresses it must be supplemented. Thus different conditions presenting at different stages before and after gross histologic changes have occurred, may modify our methods, but not the underlying principle. If I have been unduly repetitive in stating this great truth, it is because the wildfire spread of a delusionary practice like the use of Koch's *tuberculin* seems almost to indicate a forgetfulness on the part of medical men in all countries of some of the first principles of their art.

This being fully understood, we may with less fear of leading to an exaggerated estimate of their importance, discuss some among the many measures that have been proposed for the treatment of the lesions, the toxæmia, and the special symptoms arising in the progress of cases of the various forms of tuberculosis.

First, however, something must be said of

Acute Disseminated Tuberculosis.

This fulminating disease, the *acute miliary tuberculosis* and *acute general tuberculosis* of authors, has been by some writers[1] discriminated sharply—and, *Bacillus tuberculosis* notwithstanding, I am more and more inclined to believe, properly—from such affections as acute or chronic pulmonary consumption. It is rather an acute, possibly autogenous infective fever, comparable in many respects with the exanthemata, than such a process as we have had in mind in our preceding studies. Nevertheless, I believe that congenital or acquired hypotrophy is still the basic element. One of the most rapid cases I know of was in a young man aged twenty-five years whose father had died

[1] Niemeyer, *Lehrbuch der Speciellen Pathologie und Therapie*, Berlin, 1856, p. 242; Ruehle, Buck's ed. of *v. Ziemmsen's Cyclopœdia*, N. Y., 1875, vol. v. p. 614.

of pulmonary phthisis, and whose mother had died of cancer. The patient had been well cared for, and was apparently well up to the time of the attack. He had a chest expansion of three and one-half inches. He was not my patient, but I had examined him for life insurance; postponing him on his family history, despite his apparent health at the time of examination.

That this fever, or something indistinguishable from it, frequently supervenes upon ordinary pulmonary phthisis and other forms of localized tuberculosis, giving rise to the clinical phenomena immediately preceding death, seems to be true. That in a "susceptible" subject it may be produced by injections of *tuberculin* seems also to be true;[1] and in this fact may ere long be found the key to many of the perplexing problems that at present prevent satisfactory pathological or clinical classification.

While in some instances the causation cannot be proved, the most generally accepted view refers the origin of acute disseminated tuberculosis in all instances to some nidus of bacilli from which these organisms or their spores enter the circulation,[2] perhaps through the thoracic duct (Ponfick) or by involvement of a vein (Weigert). Intestinal entrance of bacilli is said to be common.

The older view (Buhl, Hamilton, and others) of auto-inoculation with caseous matter seems to me nearer the truth, which I venture to predict will be ultimately demonstrated to be auto-inoculation with some toxic katabolin, some product of "perverted zymosis," perhaps resembling *tuberculin*. The rare cases in which acute disseminated tuberculosis supervenes upon typhoid fever lend some color to this view, as practically enunciated by Birch-Hirschfeld.[3] The whole subject, however, hinges upon, and awaits determination of, the true rôle of Koch's bacillus.

In the child acute miliary tuberculosis is more frequently markedly generalized than it is in the adult. In both, however, it shows considerable predilection for the lung,[4] and next apparently for the meninges; but the intestines and peritoneum are invaded more often than general post-mortem statistics indicate. By many authorities of the first rank the disease is described as a pulmonary affection, *acute phthisis* (Laen-

[1] See cases and remarks of Virchow, *Deutsche med. Woch.*, Mar. 12, 1891; Rütimeyer's case of acute tuberculous meningitis, *Berlin. klin. Woch.*, Feb. 2, 1891; and many others in the current journals.

[2] Recent researches in point are those of H. L. Loomis, *Med. Record*, N. Y., Dec. 20, 1890, and Northrup, *N. Y. Med. Journ.*, Feb. 20, 1891, on tuberculous bronchial glands in children and adults.

[3] Cited by Ruehle, *op. cit.*, p. 626.

[4] Leroux publishes from the note-book of Parrot (*Études expér. et clin.*, t. ii. p. 1, *et seq.*) a series of extremely interesting observations on 219 infants, from one day to two years old.

nec, Louis, DaCosta), and the hepatic, splenic, intestinal, and other lesions are treated as complications. DaCosta,[1] indeed, makes no fundamental distinction between acute miliary tuberculosis of the lungs and "galloping consumption."

Whether it affect principally or even exclusively the lungs (*acute* [pulmonary] *phthisis*), the meninges (*acute tuberculous meningitis*), or the peritoneum (*acute tuberculous peritonitis*), assume the aspect of a general fever with intestinal lesions (*typhoid type*), or be frankly generalized from the outset (*acute miliary tuberculosis*), the disease is the same and the treatment is based upon the same principles. The prognosis is of the gravest. Flint[2] writes: "This is one of the diseases in relation to which, recovery is proof of an error in diagnosis." Ruehle similarly says:[3] "In the two cases of recovery which I have seen where this diagnosis was made I prefer to suppose that a blunder was committed." According to Jacobi,[4] "the large number of recoveries sometimes reported does not agree with the experience of those who see their cases from beginning to end. A single visit does not suffice to make the diagnosis." Wunderlich,[5] Waller,[6] Lick[7] and Burkart,[8] however, have reported cases of recovery from acute miliary tuberculosis. DaCosta[9] teaches that recovery is possible, and states that he has seen a number of cases in which the acute symptoms subsided, passing into chronic phthisis. McCall Anderson[10] has recently added to the indubitable cases previously reported by him[11] of recovery from acute phthisis; and the same observer has recorded at least one convincing observation of recovery from acute tuberculous peritonitis.[12]

I have met with one instance of surprising and unexpected recovery in a case which I had after some hesitation diagnosticated as acute general tuberculosis of the pneumo-typhoid type. In this patient, who exhibits markedly the "phthisical habitus" of Rokitansky, the disease began in the manner on which stress has been laid by Laveran[13] as an arthritis, and later exhibited pulmonary and pleural signs. The typhoid condition was marked and the diagnosis of typhoid fever canvassed, but the temperature course and the absence of rose-spots and of splenic enlargement negatived this view. After full restoration to strength and weight there persist signs of consolidation at the left apex,

[1] *Medical Diagnosis*, 7th ed., Philada., 1890, p. 338, and personal teaching.

[2] *Practice of Medicine*, p. 227, 5th ed., Philada., 1881. [3] *Op. cit.*, p. 630.

[4] *Op. cit.*, p. 181.

[5] "Zür Heilbarkeit der Acuten Miliartuberkulose," *Archiv f. Heilk.*, 1860. These cases are not beyond doubt.

[6], [7], [8] Cited by Ruehle, *loc. cit.* [9] *Lectures*, unpublished.

[10] *Loc. cit.*

[11] *Lectures on Clinical Medicine*, London, 1877, p. 156, *et seq.* Not all of these cases, however, are considered by Anderson to have been tuberculous.

[12] *Op. cit.*, p. 152. [13] *Le Progrès médical*, Oct. 25, 1876.

upper posterior portion of left lower lobe, left base, right apex, and two or three small areas over the right middle lobe. Mistaken diagnosis or not, it is well, while admitting the gravity of the situation, to make a hopeful and aggressive battle in every case that seems to be acute tuberculosis. At the same time, in choosing from among different agents and measures those to be used in an individual case, the comfort of the patient must be a prime consideration. Purely symptomatic and palliative medication is fully admissible.

Whether pulmonary or other symptoms predominate, it is to be remembered that we are dealing with a specific intoxication somewhat resembling smallpox in the nature and distribution of its lesions, and closely resembling typhoid fever in all other respects. These facts give the clue to treatment, which must be stimulating, supporting, antifebrile, and antiseptic. Even when the diagnosis has not been made and treatment has been instituted as for typhoid fever—which is the most probable mistake—if that treatment be suitable for the case as one of typhoid fever, it will be fairly suitable for the case as one of acute miliary tuberculosis. Due allowance being made for individual conditions, the following general plan may be followed:

Food is to be administered very much as in a bad case of typhoid fever; for exactly the same indications present, often even to intestinal ulcerations. *Milk* may be given in small quantities, cold if there be much pyrexia, at intervals of two hours or less, day and night. *Peptonized milk* is usually preferable. *Koumyss* will sometimes be retained when other preparations of milk are rejected. *Matzoon* might be tried if koumyss failed. *Peptonized beef-tea* is both nutrient and stimulant, and may be given in alternation with the milk or as may be most advisable. *Peptonized milk gruel* combines a partially digested carbohydrate with the nitrogenous food, and is especially useful in cases attended with considerable elevation of temperature. Unless there is a marked tendency to diarrhœa, *soups*, *broths*, etc. may also be used. When the more nutritious foods cannot be retained, the stimulating foods of low nutritive value, such as *Liebig's extract*, *beef-juice*, *beef-tea*, *whey*, *wine-whey*, and the like, may be used in small quantities at short intervals. *Alcohol* is likewise a food under these conditions, and may be given freely; preferably in the form of iced champagne, but any other available form that does not cause vomiting is allowable. The quantity will depend on the general conditions presented, and its medicinal value as an antiseptic is not to be forgotten. Some prefer small quantities, given with the food at frequent intervals. I have given rather large doses, and when I could not get wine have used spirits or flavored mixtures in quantities equivalent to a half ounce or more of whiskey or brandy every two hours, preferably in milk. Perhaps I have erred in this, as I am beginning to find out that Gairdner, Rich-

ardson, and N. S. Davis are not entirely astray in their estimate of the much more restricted field of alcohol. Whether large or small doses be given, if it cause vomiting its use must be mitigated, suspended, or given up. Vomiting may be checked by *ice, cold aërated waters, diluted hydrocyanic acid* (♏ij–v), *carbolic acid* (♏j) *tincture of iodine* (♏ij), *cocaine hydrochloride* (gr. $\frac{1}{8}$); sometimes by a *mustard plaster* or an *ice-bag* over the epigastrium. Nourishment by *stomach-tube*, by *enema*, or by *inunction of cod-liver oil* may be required.

Fever is to be combated by the administration of *ice, ice cream*, and *cold drinks*, and by *cold applications*, such as the *bath, ice-pack, cold sponging, Leiter's coil* to the neck, etc. An *ice-cap* or *Leiter's coil* to the head is of great use, even in the absence of headache or any meningeal symptoms. When there is meningitis it often gives great relief. An *ice-bag over the heart* helps to soothe and strengthen that organ and to bring down temperature.

Continuous *cold applications to the abdomen*, either by *coil, wet cloths* constantly changed, an *ice-bag*, or other available method, are of service, and in McCall Anderson's[1] cases of acute phthisis, previously cited, seem to have helped to save life.

Antipyrin, acetanilide, and similar drugs which simply depress temperature, and do so at the expense of vital energy—with, too, increase of toxæmia by interference with excretion—cannot do good and may do much harm. Of drugs used for antiseptic and antipyretic effect we may choose among the following: *quinine, salicylic acid*, or *sodium salicylate* in the usual doses; *iodoform*, if it can be retained, in doses of from one to five grains three times a day, or by suppository in equivalent dosage, or hypodermatically dissolved in sterilized olive oil, almond oil, or liquid vaseline (15 to 30 minims of a 1 to 4 per cent. solution, once, twice, or thrice daily); *creasote* by the stomach in three or four doses aggregating 15 to 20 minims in the twenty-four hours, or hypodermatically in sterilized olive oil or liquid petrolatum, in smaller doses, less frequently; *eucalyptol* in similar dosage or by continuous inhalation; *ethyl iodide* by inhalation, without much regard to dosage, as it is difficult to judge how much is absorbed.[2] Of these I prefer *quinine hydrobromate* (gr. xx–xxx per diem in two or at most three doses, massed for effect six hours later), *creasote* (♏ij–v, *p. r. n.*) and

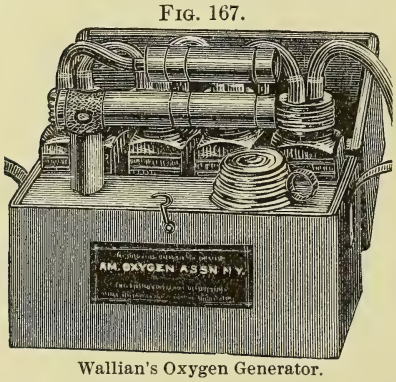
[1] Anderson lays much stress on his method. Two nurses were employed, changing the cold flannels every minute for half an hour, every two hours, so long as the temperature exceeded 100° F. A tub of ice-water stood by the bed; one nurse dipped the cloth, the other applied the fresh one, and handed the old one to her mate to be again cooled. Each cloth was sufficiently large, when folded into four layers, to cover the whole of the front and the sides of the abdomen.

[2] Ten or more minims of ethyl iodide may be dropped on a sponge or a cotton wad and held to the nostril, or the phial containing the drug be opened and held to the nose or mouth for two or three minutes, or the "bead inhaler" be used.

ethyl iodide (frequently by inhalation). Inhalation of *ammoniated chloroform* after the method of Richardson,[1] might rationally be resorted to.

Hydrogen dioxide (10 vol. solution) may be given in doses of from one to four tea-spoonfuls in glycerin or water at intervals of three hours or less, as an antiseptic and nutrient. *Ozonic ether* may be similarly given in doses of a tea-spoonful or two, or, especially if collapse be threatened, by hypodermatic injection of an ordinary syringeful (15 to 30 minims). Inhalations of *oxygen* undiluted, or diluted with air or with nitrogen monoxide, may be given, especially if the patient be unconscious or delirious, or exhibit signs of cyanosis. Under such circumstances, as the inhalations are made independently of the patient's volition, a continuous stream should be kept up; the delivery-tube being inserted into mouth or nostril as may be more convenient or safer. There will be considerable waste of gas, but that is not a very serious matter. I prefer recently-made oxygen. One of the most convenient apparatus for its manufacture and administration is that of Wallian (Fig. 167). Cylinders of the compressed gas may, however, be employed. Valenzuela has given oxygen by enema. I have no experience with that method, but am inclined to make trial of it hereafter. In cases presenting marked pneumonitic phenomena *amyl nitrite* or *nitro-glycerin* may be used with advantage. Recent experience in phthisis (Shurly) indicates that in the cases under discussion *iodine* dissolved in glycerin with the aid of potassium iodide may be administered hypodermatically without any bad result and with the expectation of good ones. The dose would be from $\frac{1}{12}$ grain to $\frac{1}{2}$ grain of iodine once or twice daily, proceeding cautiously and tentatively. To relieve pain, check distressing and fruitless cough, or control inflammation I prefer *codeine sulphate* (gr. $\frac{1}{8}$ to $\frac{1}{2}$, *p. r. n.*) above other derivatives of the poppy. In meningitis, however, *morphine* will usually be necessary, and *chloral* or *hyoscine hydrobromate* may be used.

FIG. 167.



Wallian's Oxygen Generator.

If lesions can be located, *counter-irritation* of the skin of the overlying region by iodine, croton oil, or both, may be fearlessly carried out. Turpentine stupes or sinapisms may likewise be applied. I would not use cantharides. Excessive diarrhœa may call for treatment; in which case *salol* (gr. v), *Beta-naphthol* (gr. v), or *bismuth salicylate* (gr. x) may

[1] *Asclepiad*, 1884, vol. i., p. 32; 1889, vol. vi. p. 286.

be tried, and if these fail, *opium* or *astringents* (hæmatoxylon, rhatany, etc.), *creasote*, or *carbolic acid and iodine*, may be given. *Enemata* of *creolin* (fʒj *ad* Oj) or of *starch* and *laudanum*, or *suppositories* of *opium* and *belladonna* may be used. *Strychnine sulphate* (gr. $\frac{1}{60}$ hypodermatically or gr. $\frac{1}{30}$ to $\frac{1}{20}$ t. d. *per os*) is useful to maintain cardiac and respiratory action, and I think aided recovery in the case I have cited. *Atropine sulphate* (gr. $\frac{1}{200}$ to $\frac{1}{60}$) may be given as indicated (Anderson) if excessive perspiration be thought to call for special treatment; but unless the sweats seemed to be prostrating or otherwise harmful I should hesitate to close any channel of elimination, and should rather seek to modify the process by sponging with tepid water containing salt and alcohol or quinine. *Ammonium carbonate* (gr. v from every second hour to every fourth hour) is of service, especially in the pulmonary form of the disease, as a cardiac stimulant and for its influence upon the respiratory mucous membrane. *Ammonium salicylate* (gr. v to gr. x) seems to add decided antiseptic powers to the ammonium effect in general. In the case of recovery noted, being at first under the impression that it was a case of broncho-pneumonitis of influenza, I used for a time the following mixture:

Ammonium carbonate,	5 gr.;
Ammonium salicylate,	5 gr.;
Fluid extract of erythroxylon,	1 fluidr.;
Spirit of nitrous ether,	1 fluidr.;
Glycerin,	$\frac{1}{2}$ fluidr.;
Solution of ammonium acetate,	$1\frac{1}{2}$ fluidr.;

To make a table-spoonful. Give every third hour.

It will be seen that in this combination it is also designed to keep the kidneys fairly active, in order to promote elimination of morbid products. Erythroxylon has some utility as a gastric sedative, as a cardiac stimulant, and as a diuretic, and it better covers the ammonium taste than does any other preparation I know of. *Digitalis* (gtt. v–xx of a reliable tincture) will sometimes serve better than any other remedy, the condition of the circulation being the guide. *Amyl nitrite* (♏iij–v) by inhalation or internally (with alcohol fʒss and glycerin fʒss, in water) will assist the action of the digitalis. A good tincture is the most available digitalis preparation, as the active principles of leaves or extract require to be elaborated in the stomach, and time is an object. When it is desired to act on the kidneys specially, the tincture may be given in the infusion.[1]

McCall Anderson used *ammonium carbonate* (gr. v), *syrup of squills* (♏xv), and *infusion of senega* (to make a table-spoonful), three times

[1] *Vide* Eshner, *Proceedings Phila. County Med. Society*, 1891.

a day, but abandoned this mixture for the combination known as "Niemeyer's pill," which consists (as variously modified) of *digitalis* (gr. $\frac{1}{2}$–gr. j), *quinine sulphate* (gr. j), and *opium* (gr. $\frac{1}{4}$–gr. j).

If recovery take place, convalescence is to be managed on general principles, and especially with a view to such reinvigoration as shall prevent the development of acute or chronic tuberculosis in the future. It seems unnecessary to enter now into detail. The patient should be gotten into the open air, and if practicable into the country, as soon as possible. Of appropriate medicines, *nux vomica*, *cinchona*, *iron*, *manganese*, *gold*, *arsenic*, *iodine*, *ammonium iodide*, *calcium and sodium hypophosphites*, and *cod-liver oil* may be mentioned.

Acute disseminated tuberculosis begins at times with

Marked Initial Location.—A case of primary tuberculosis of the larynx that I had the opportunity of observing in the practice of J. Solis-Cohen [1] was a typical instance. In such cases the general treatment, dependent somewhat on symptomatology, will not differ from that just discussed. Local treatment will be mainly palliative, and till we have better knowledge will be governed by the same principles as apply in acute and chronic localized tuberculosis.

Acute and Chronic Localized Tuberculosis.

We now return to the diseases that we have from the first been considering—those, namely, which depend less on infection than on some antecedent structural or functional fault of the organism. There is a seeming paradox to be explained. Under the head of disseminated tuberculosis we have included processes localized in one organ or even in a portion of that organ. Under the head of localized tuberculosis we shall here include processes eventually involving considerable areas, or even the whole of an organ, or perhaps several organs simultaneously. Yet the distinction is a true one. Acute disseminated tuberculosis, whether the local lesions be great or small, is to be grouped with infective fevers; the dissemination *in loco* being its anatomical characteristic. Localized tuberculosis, whether acute or chronic, limited or widespread, represents the local expression of a diathesis. The particular localization (leaving aside the question of infection) is determined by traumatism, as in the case of many joint-lesions, or by inflammations, as in many cases of pulmonary phthisis, or by other local circumstance, injury, or defect in other forms of the disease; and the morbid alteration of structure is, at first at least, concentrated *in loco*. Discrimination should be made, it is true, between such processes, for example, as phthisis florida and chronic fibroid phthisis, primary tuberculosis of the larynx and the late laryngeal thickening and ulcerations of chronic pulmonary phthisis; but our knowledge

[1] Case of a sailor, reported in the *American Journ. Med. Sci.*, Jan., 1883.

will not permit this to be done with accuracy under a classification by names of either pathologic or clinic derivation. Under all the circumstances, the most convenient method of study for therapeutic purposes will be under the heads, respectively, of Toxæmia, Lesions, and Special Symptoms.

Treatment of Toxæmia.

From time to time a variety of agents have been proposed, as of special, if not specific, virtue, in the treatment of tuberculosis. Various theories of their action have been propounded in accordance with the notions of pathology and drug-action prevailing at different times. Some of these agents have received discussion in connection with the subjects of inhalations and of prophylactic medication. In the absence of better knowledge, I shall here discuss some drugs previously mentioned, and such others of the class under consideration as appear to be of sufficient importance, as if it had been ascertained that their action is to combat toxæmia.[1]

The first and most important matter is, of course, to secure prompt and thorough elimination of the waste products of normal and morbid tissue-change, and to endeavor by the same means to get rid of noxæ circulating in the blood or stagnating in the lymph-channels. Thus we find, again, an urgent indication for keeping the skin clean, the circulation and the respiration active, and all the emunctories in as good condition as possible. I am inclined to think that subcutaneous injections of water at 98° F., containing 0.73 per cent. of sodium chloride ("normal solution"—about 56 grains to the pint), after the method of Sahli,[2] will prove useful in conditions of deficient elimination in acute or subacute cases; but as yet my experience is too limited to warrant more than a suggestion of the practice. In addition certain medicaments may be used as antidotes or antagonists to the noxæ suspected or known to be present in the fluids.

It is well to bear in mind a number of these agents. None is a specific, but all are more or less useful; and individual peculiarities may cause one to be well borne or effective where another fails. I shall briefly indicate any special applications of which I feel tolerably assured.

Two drugs must be given foremost rank—I hold them in equal estimation—*iodoform* and *creasote*. While, as a rule, they have individual indications, I am sometimes in doubt which to use in a particular case, and try first one, then the other, then the two in combination. That they do not act by destroying bacilli in the blood or

[1] P. Villemin has tested a large number of agents as to their powers over the development of the *Bacillus tuberculosis*, and the curious on this point may consult his report, *Étude expér. et clin., etc.*, t. ii. p. 237, *seq.*

[2] Cited *Brit. Med. Journ.*, Sept. 20, 1890.

tissues scarcely requires statement, and the quantities employed by internal administration can hardly exert any influence directly upon cellular processes. We must look to chemistry for the proximate explanation; but, whether or not explanation be forthcoming, that they do have beneficial action, manifested by local and general improvement, clinical evidence cumulatively demonstrates.

Iodoform was used by Glover[1] (two grains in breadcrumb three times a day) in the treatment of various tuberculous affections, and Rhigini[2] recommended, as well, the ethereal solution as an inhalation of great value in retarding the progress of phthisis. In recent times its internal administration has been most prominently advocated by Semmola,[3] Dreschfeld,[4] and Shingleton Smith.[5] While its bacillicidal powers are probably feeble, its antituberculous powers as a topical agent are attested by clinical evidence that cannot be shaken.[6] Some persons have an idiosyncrasy against it, and caution must therefore be exercised when prescribing it for the first time in any case. It has thus far been my fortune, however, not to meet with a severe case of iodoform-poisoning, the worst I have seen being cutaneous eruptions from external use of the drug. Fatty degeneration of the liver was produced by Gibbes and Shurly[7] in their experiments on animals, but I do not fear this in clinical work. The drug is best given in capsule, beginning with 1 grain and increasing to 5 grains, three or four times daily, after meals. Crude semisolid petroleum or one of the purified petroleum products (gr. ij–v) is a good excipient and adjuvant. Huchard uses powdered benzoin and balsam of Tolu to make up a mass for sugar-coated pills. Balsam of Peru may also be used, and possibly Canada balsam. I frequently combine iodoform with arsenic iodide (gr. $\frac{1}{24}$ to $\frac{1}{12}$) and reduced iron (gr. j–ij) or iron iodide (gr. ij); sometimes with powder of digitalis (gr. ss–gr. j) as well. The indications for these drugs have been discussed. Gelatin-coated and sugar-coated pills containing iodoform alone or combined with other drugs are offered for sale, but they are not always reliable. I prefer extemporaneous prescription and manufacture. If the patient cannot afford to pay for capsules, a little glucose may be added to an ordinary pill. It is not so very unpleasant to take, and tolerance is soon established. The addition of a small dose of extract of hyoscyamus (gr. $\frac{1}{8}$) will sometimes

[1] *Edinb. Month. Journ. Med. Sci.*, Feb., 1848, with reference to earlier publication and to the observations of Cogswell and Lichtheim.

[2] *Journ. de Chim. méd.*, Feb., 1853, cited by J. Solis-Cohen, *op cit.*, p. 110.

[3] *Giorn. Internaz. delle Scienze Med.*, 1882, fasc. 7 e 8, p. 848.

[4] *British Med. Journ.*, July 29, 1882, p. 169.

[5] *Trans. Int. Med. Cong. Copenhagen*, vol. ii. p. 33; *London Medical Record*, May 15, 1886.

[6] *Vide* Pilcher, "Trans. American Surgical Assn.," 1889, *Med. News*, June 1, 1889, p. 610.

[7] *Loc. cit.*

cause iodoform to be better borne by a squeamish stomach, or a drop or two of dilute hydrocyanic acid, or a powder of cocaine (gr. $\frac{1}{8}$) with bismuth (gr. v), may be given shortly before the iodoform is to be taken.

Iodoform is sometimes given subcutaneously, dissolved in olive oil, almond oil, or one of the bland petroleum products, and very often in combination with eucalyptol and the like. Meunier's formula is 5 per cent. eucalyptol and 1 per cent. iodoform in liquid vaseline. Excellent results were obtained by Morel Lavallée[1] from injections of this solution (30 minims daily) in cases of scrofulo-tuberculosis of the skin.

Iodoform may also be administered for constitutional effect by inhalation, either with turpentine, eucalyptol, or creasote, in ethereal solution or dissolved in chloroform. When applied locally, whether superficially in powder, ointment, or lotion, or by injection into a cold abscess or other so-called surgical lesion, some portion is absorbed and acts constitutionally.

Chauvin and Jorissenne[2] highly recommend rectal injections of iodoform made up with gum tragacanth, and Flick[3] uses inunctions of iodoform in cod-liver oil, from which he thinks he obtains specific results far superior to those obtained in the ordinary way.

Iodoform is of great value in restraining the histologic development of tubercle and in preventing or checking suppuration and tuberculous necrosis. It promotes healing when topically applied to abscesses, sinuses, and ulcerated surfaces, and as a pigment or ointment is one of the best applications to glandular enlargements of scrofulous or tuberculous origin. Nillson[4] alleges a cure of undoubted tuberculous meningitis by friction on the shaved scalp with iodoform ointment (1 : 10).

It is said that the action of iodoform depends upon free iodine, which it liberates in the blood or in contact with the tissues. If so, there must be some special virtue in the nascent state of the element, for ordinary iodine is not equally efficacious, at least in my experience, even when injected hypodermatically, as advised by Shurly.

If iodoform cannot be taken, however, iodine may be given, either subcutaneously or in the form of the compound tincture or compound

[1] *Études expér. et clin.*, t. ii. p. 125, *seq.*

[2] *Cong. de la T.*, f. i. p. 640.

Iodoform,	30 grains;
Gum tragacanth,	6 grains;
Water,	6 ounces.
For 20 injections.	

[3] *Proceedings, Phila. County Med. Soc.*, 1891.

[4] *British Med. Journ.*, Nov. 21, 1885.

solution internally, in doses of from 1 or 2 minims to as much as will be borne by the stomach. Jaccoud[1] gives scrofulous patients, that cannot take sufficient cod-liver oil, iodine in milk. Syrup of hydriodic acid may be administered, beginning with 10 minims well diluted, and running up to the largest doses that are well tolerated. *Ammonium iodide* has a special application as a stimulating resolvent and sorbefacient in cases of chronic pneumonitic phthisis. *Potassium iodide* can, I think, be only harmful in any but syphilitic phthisis, and I have not seen reason to give it in any form of tuberculous disease. I have already spoken of the inhalation of *ethyl iodide.*

The cases in which I most frequently resort to the internal administration of iodoform and iodine compounds are those of pulmonary or laryngeal tuberculosis, without much fever, in scrofulous subjects. If proper nourishment be afforded, great gains in weight take place, coincidently with mitigation in pectoral symptoms and improvement in local conditions, as evidenced by physical signs. The drug is of special benefit in the early stages, but may also be used with advantage in cases presenting extensive cavities. In these, however, and in the early stages, if there be much fever, I prefer *creasote,* or sometimes combine creasote and iodoform in the same capsule, or to more readily regulate the dose give them coincidently in separate capsules.

Beechwood creasote should be used, Morson's being the best preparation I know. Very often disappointment experienced on using an inferior drug will be changed to satisfaction on using the better preparation. Creasote is a complex product, and, like opium or digitalis, is not entirely represented by any of its constituents, although recent observers, following Sahli,[2] have reported very favorably on the use of *guaiacol.* I was taught to use creasote in small doses, from half a minim to one or two minims. Since Sommerbrodt[3] published his experience with large doses, however, I have followed the method of that observer, and with the utmost satisfaction. Beginning with 2 drops thrice daily as a tentative dose, I push it by gradual increment to 15 or 20 minims daily, divided into three or four doses of 5 minims each. It must never be given on an empty stomach. The formula I most frequently use is as follows:

℞. Beechwood creasote (Morson's), 32 to 80 minims;
Glycerin, 2 to 4 fluidounces;
Tr. cardamom, 2 to 4 fluidrachms;
Alcohol, enough to make 4 to 8 fluidounces.
Mix.

Dose, two to four teaspoonfuls (representing 5 minims of creasote as a

[1] *Op. cit.,* p. 161.

[2] *Correspb. f. Schweitzer Aertze,* 1887, No. 20, p. 616, cited in *Lancet,* Dec. 24, 1887.

[3] *Berlin. klin. Woch.,* 1887, No. 15, p. 258.

maximum), in three or more ounces of water, three to five times a day, after food.

Following Jaccoud, I sometimes use St. Croix rum as the alcoholic preparation; many patients prefer it. Bouchard and Gimbert[1] used the following excellent formula:

℞. Creasote, 13 grammes .50; (*circa* fʒiijss;)
Tincture of gentian, 30 grammes .50; (" fʒj;)
Alcohol, 250 grammes .50; (" fʒix;)
Tokay or Malaga wine, enough to make 1 litre, (Oij). Mix.
Dose, two to four teaspoonfuls in the course of twenty-four hours; each teaspoonful in a glass of water.

Creasote may also be given in capsule, which is Sommerbrodt's method. Chapoteaut's capsules of creasote and morrhuol are those I most often use; from one to five capsules being given at a dose after food. Shaken up with cod-liver oil (2 to 5 drops of creasote in a table-spoonful of oil), it is not very unpleasant. Jaccoud[2] prefers cod-liver oil either to capsules or wine as a vehicle for creasote. He believes the drug acts not only on the catarrhal, but also on the tuberculous processes, causing sclerotic change to predominate over necrosis or caseous degeneration. It has also an antiputrid effect, thus tending to avert the fever of absorption. Its effect is slowly produced, but is permanent, and its use should be long continued. He gives small doses, beginning with 3 minims daily, increasing by 1 minim every week or ten days, until a dose of 5 or 6 minims is reached as a daily maximum not to be exceeded. Indeed, it is rarely attained, as he finds small doses equally effectual and less likely to cause gastralgia. Gastralgia is the only counter-indication. His prescription is—

℞. Beechwood creasote, 3 to 6 minims;
Essence of peppermint, 1 minim;
Cod-liver oil, 2 fluidounces.
Mix. To be taken in twenty-four hours;

or if glycerin be used instead of cod-liver oil, the daily dose consists of—

℞. Creasote, 3 to 6 minims;
Essence of peppermint, 1 minim;
Cognac or rum, 3 fluidrachms;
Glycerin, 1½ fluidounces.
Mix. Small table-spoonful four times a day.

Milk is sometimes a good vehicle for creasote. They must be well

[1] *Gaz. hebdomadaire*, 1877, No. 31, p. 488.

[2] *Op. cit.*, p. 156, *et seq.*

mixed by thorough shaking. J. Rosenthal[1] gives creasoted carbonic-acid water, of which one quart contains about an ounce of cognac and from ten to twenty minims of creasote. Dor[2] advocates endotracheal injections of creasote dissolved in sterilized olive oil (1 : 20), of which he uses about 30 minims twice daily. The solution is introduced by means of a curved syringe and under laryngoscopic guidance. After injection the patients are made to assume positions that will favor the gravitation of the fluid to the diseased portions of the lung. By this means, it is claimed, both local and constitutional effects are produced. Dissolved in almond oil or olive oil, in vaseline, or other purified liquid petroleum product, creasote may be given subcutaneously or injected into lung-tissue or cavities. Rosenbusch[3] injected into each of two spots in the apex of the lung affected 8 minims of a 3 per cent. solution. From three to five minims of creasote is as much as I have ventured to inject at one dose, either into the lungs or the subcutaneous tissue. W. H. Flint[4] saw benefit from rectal injections of milk (four ounces) containing an emulsion of creasote in cod-liver oil (one or two drachms, each drachm being equivalent to two minims of creasote). The injections were made every five or six hours. When the rectum became intolerant, a small amount of laudanum was added to the enema. In whatever way this drug be given, it must be pushed and persisted in.[5]

Bogdanovitch[6] administered to himself as much as 44 grains (minims?) daily by gradual increase of dose. Vertigo and disturbed circulation ensued when so much as 12 grains was taken at one time or if 20 grains were taken in the course of one hour; but the toxic symptoms soon passed off.

In small doses creasote assists digestion, probably by preventing decomposition and fermentation processes in the alimentary canal. It prevents and checks diarrhœa. In larger doses it reduces temperature and, as shown by the altered character of the discharges, helps to correct the septic processes in excavations and bronchiectases, besides

[1] *Berlin. klin. Woch.*, 1888, No. 32.
[2] *Rev. de méd.*, Feb., 1890.
[3] Cited *Med. News*, April 28, 1888.
[4] *N. Y. Med. Journ.*, July 26, 1890.
[5] Illustrative formulæ of combinations I have found of use are—

℞.

Creasote, 1 minim;
Iodoform, 2 grains;
Crude petroleum, 2 grains;
Licorice, } a sufficient quantity.
Benzoin, }
Mix.

In capsule.
One three times a day, after meals.

℞.

Oil of gaultheria, 2 minims;
Creasote, 5 minims;
Donovan's solution, 5 minims;
Cod-liver oil, 2 fluidrachms;
Acacia, } a sufficient quantity;
Sugar, }
Water to make an emulsion of half an ounce. Mix.
After meals, three times a day.

[6] Cited *British Med. Journ.*, Mar. 10, 1888.

serving to bring about recession in local and general morbid phenomena. I believe that it stimulates the bronchial and alveolar epithelium to healthier action. It is indicated in acute miliary tuberculosis, early phthisis of the rapid variety, late phthisis with fever, and in any variety when conditions of ulceration, softening, excavation, or putrefaction are present. I am not able to elucidate the method of its action. To call it an antiseptic is simply stating the fact, not explaining it.

Sahli's formula for the administration of *guaiacol* is as follows:

℞.	Guaiacol,	1 to 2 parts;
	Alcohol,	20 parts;
	Water,	180 parts. Mix.

One to two tea-spoonfuls in a glass of water, or larger doses in cod-liver oil, are given three times a day after meals.

Solutions of guaiacol should be kept in colored glass bottles, as when exposed to the light a resinous deposit takes place. Guaiacol may also be given in pill-form or capsule in the same dose as creasote. *Carbolic acid* may be used in place of creasote, but it is not equal to the latter therapeutically. Why, I do not know.

Thymol is a near relative of creasote and carbolic acid, and has been urged as a substitute; it may be given in doses of from two to five grains in capsule or pill with soap. Philipowicz[1] gave 45 grains daily. I have never given more than 25 grains daily, and seldom exceeded 15 grains. I have not observed any advantage of the drug over creasote, except occasionally in the treatment of diarrhœa, and since salol was introduced I have had little occasion to resort to thymol. The *naphtha* given by James Hastings—concerning which Wood[2] doubts as to whether it was pyroacetic spirit (acetone), as Hastings distinctly states, or pyroxylic spirit (crude methyl alcohol), which Hastings as distinctly says it was not[3]—should be included in this group of drugs. From the reports of Hastings and his correspondents I have no doubt that it is a useful remedy. It is a fact worth noting that while he complained of the difficulty of getting the "medicinal naphtha," and not some deleterious substitute, and said that even of the medicinal naphtha he had seldom seen two samples exactly alike from the same manufactory, he obtained the best results with that made from beechwood. The dose was from three to twenty minims in water, three times a day. Attacks of intercurrent bronchitis or other inflammatory process necessitated suspension of the remedy. In febrile cases or cases with cavities it did not answer so well as in apyretic cases

[1] *Wiener med. Presse*, Jan. 6, 1889. [2] *U. S. Dispensatory.*

[3] *Pulmonary Consumption Successfully Treated with Naphtha*, 2d ed., London, 1845, pp. 152, *et. seq.*

before cavity-formation. By inhalation it relieved cough and dyspnœa. *Beta-naphthol* has been given, but principally for its local effect on the alimentary tract, as it is not absorbed to any extent.

All these drugs are eliminated in part by the lungs, and hence act locally. Thus, Eichhorst,[1] finding the indication in putrefactive processes in the respiratory passages, which the drug favorably influences without staying the progress of the tuberculosis, administered *myrtol* in capsules containing two grains each, of which two were taken every second hour.

C. Theo. Williams[2] has used *sodium sulpho-carbolate* (gr. vij–gr. xx, *t. i. d.*), as also *phenylacetic acid* and *phenylproprionic acid* (gr. x–xx), which latter "have the merit of being singularly agreeable medicines, resembling honey in taste and smell." These all seemed to have in a fair proportion of cases a good influence upon the general condition of the patients, and to mitigate symptoms of phthisis.

Ammonium borate has been found of great benefit by Lashkevich.[3] He gives internally 5 grains, three times a day, in solution, either alone or combined with codeine, hyoscyamus, or other sedative. It produces, he says, diminution of pyrexia, allays cough, and improves the character of the expectoration. I should think it would be extremely useful in special conditions. I have not tried it as yet.

Boric acid has been given by Pini[4] in doses of 30 grains daily. Some caution is to be observed with this drug, inasmuch as cases of poisoning are on record, and Grancher killed guinea-pigs in fourteen days with a daily dose equal to $\frac{1}{600}$ of the animal's body-weight.

Luton[5] gives copper acetate (gr. $\frac{1}{6}$) and crystallized sodium phosphate (gr. $\frac{5}{6}$) in pill or solution with a bland excipient, in order to have a double decomposition occur in the stomach, producing recent *copper phosphate* in an alkaline medium. He also uses recently precipitated *copper phosphate* subcutaneously. I have not tried the method, but deem it worth mention.

Ceccherelli[6] has revived the use of *tannin*, more especially in connection with surgical procedures. He considers it as an antiseptic inferior to many other substances, but as an antituberculous agent superior even to iodoform. He dusts it freely over wounds, uses it with gauze as a tampon, or employs embrocations of tannin and collodion (20 per cent.). Raymond and Arthaux[7] have found rabbits impregnated with tannin insusceptible to tuberculosis by inoculation, and consider the drug a specific in man in all curable cases; that is,

[1] *Münich. med. Woch.*, Nov. 27, 1888.
[2] *Op. cit.*, p. 426.
[3] Cited in *Med. and S. Rep.*, Jan. 28, 1888.
[4] Cited by Schoull, *Gaz. hebdom.*, Nov. 25, 1887.
[5] *Rev. gén. de clin. et de thér.*, t. i. p. 449.
[6] *Études expér. et clin.*, t. ii. p. 281, *seq.*
[7] *Ibid.*, p. 309, *seq.*

cases in which fatal lesions have not already been produced. To infants they give iodo-tannic syrup, which is well tolerated. To adults and adolescents they give after each meal a claret-glassful of the following solution:

Tannic acid (by alcohol),	80 grains;
Glycerin,	1 ounce;
Wine,	1 quart;

or they make the drug into pill with glycerin and sugar, or give it in cachet with pepsin, the dose, augmented or diminished according to indication, being about ten pills or cachets, each containing a little less than half a grain of tannic acid. Gastro-intestinal disturbances may be produced, but tolerance is usually well established in about eight days. In febrile cases they add salicin, about 30 grains a day for an adult. It is particularly in recent and acute cases that this treatment is most useful. The observers state that in more than ten cases of tuberculous meningitis in infants they saw recovery or marked amelioration take place under large doses of the iodo-tannic syrup.

Hydrocyanic Acid and Cyan-Metals.—Hydrocyanic acid was urged as a specific in olden times, and abandoned. Recently, under the stimulus of Schroetter's observations of alleged immunity of artisans who use cyan-metals—daguerreotypists and others—and Koch's researches on gold cyanide as a poison to the bacillus, interest in the matter is partially revived. I use diluted hydrocyanic acid and preparations containing it as sedatives, to meet special symptoms.

Allusion must again be made to *cod-liver oil* and to the *hypophosphites*, inasmuch as these remedies have been lauded as of specific value in tuberculosis. They are both powerful aids to nutrition, and thus in a limited sense of specific utility in a disease based upon nutritive failure. Nevertheless, routine reliance upon one or other or both has led some practitioners to a disregard of the general hygienic measures (food, air, exercise, etc.) that may render their use entirely unnecessary.

Cod-liver oil may have some alterative virtue, due to the iodine, bromine, sulphur, and phosphorus it contains, but I believe we can secure the action of these agents better by direct administration.

Its biliary principles and its morrhuol probably assist its own and other digestion, and hence we find it indicated when there is not sufficient assimilation of ordinary food-fats. In the early apyretic stages of phthisis, when its administration is accompanied by gain of weight not otherwise obtainable, it may be given to the full quantity absorbable, which differs much in different patients. I have never used the large doses advised by Jaccoud (3 to 4 ounces daily), but have contented myself when able to reach an ounce and a half daily in three

doses. If a good method of administration can be found, the plain oil is best. If the patient cannot take it with the aid of lemon-juice or whiskey or any of the ordinary expedients, it may be given in emulsion, best made with the aid of the pancreatic ferment. Compound spirit of ether may be added to the emulsion or taken just before or after. Williams adds strychnine (gr. $\frac{1}{100}$) to cod-liver oil to facilitate digestion. When cod-liver oil cannot be taken, Jaccoud substitutes *glycerin* in doses of from two to four table-spoonfuls daily, adding to the daily dose two drachms of rum or of cherry brandy and a drop of oil of peppermint. To this same mixture he frequently adds creasote. Pyrexia he considers a counter-indication to cod-liver oil or glycerin, but the latter may be given when the former is intolerable on account of the heat of the season. If, however, the cod-liver oil is still well tolerated, he does not consider summer heat an objection to its use, though gastro-intestinal irritation, especially persistent diarrhœa, negatives its continuance.

In the treatment of children, who will often learn to take it greedily, cod-liver oil is superior to almost any other agent promotive of nutrition, and in cases of wasting without definite evidence of local disease may be used freely by inunction. So-called "marasmus" is very often due to tuberculous, or at least hypotrophic, affection of the digestive tract; and in some cases the persistent use of cod-liver oil by inunction, will help with hygienic measures to bring about recovery. The frequency of chronic tuberculosis in infants and young children is not as well recognized as it ought to be, though such standard authorities as Rilliet and Barthez, West, and Meigs and Pepper have described it. Von Mering[1] states that *lipanin* (partially saponified olive oil, containing 5 to 6 per cent. of free oleic acid) may be used as a substitute for cod-liver oil in equal doses, that it has a pleasant taste, and that it is well borne, even in summer.

Hypophosphites of calcium and sodium, according to Churchill's original formula, may be employed with a definite object at any stage of the different tuberculous diseases. That object is the improvement of nutrition by action on the blood-making and nervous systems and by the supply of bases in which the blood is deficient. In this respect I consider them superior to phosphorus, which, however, may be given, preferably as *phosphorated oil* ($\frac{1}{100}$ to $\frac{1}{50}$ grain phosphorus) and in conjunction with cod-liver oil. Their principal use and indication in pulmonary phthisis is in the early period, or before there has been much disorganization of lung-tissue; but conjoined with iodine and creasote they may be continued throughout the progress of the case. Pyrexia is not a counter-indication, and they may thus be used after cod-liver oil has had to be abandoned. While cod-liver oil is specially indicated

[1] *Therap. Monatshefte*, Feb., 1888, p. 52.

in those who do not assimilate fats, the hypophosphites are indicated in the pale, fidgety, restless individuals whose whole nervous system seems unbalanced. These are often fat and flabby—sometimes lean, but not wiry. For lean neurotics an emulsion of cod-liver oil with hypophosphites is often of great service, for the two indications coexist. In scrofulous subjects *calcium lactophosphate* is sometimes advantageously combined with cod-liver oil, from 2 to 5 grains being added to the table-spoonful of oil, in emulsion. Calcium lactophosphate is of itself at times useful, though I have been unable to settle upon any definite indications that might guide me in its administration. It is often a matter of experiment as to which calcium salt will be best borne or most effective, for I do cherish the idea, crude though it may be, that loading the blood with calcium will assist the calcifying process in tuberculous areas.

Acid calcium phosphate has been urged by Kolischer[1] for local application, and Froschauer[2] believes that the greater resistance to infections of various kinds manifested by carnivora as compared with herbivora may be explained by the greater proportion of acid calcium phosphate in their food; the natural inference being that the administration of the salt will counteract deficiencies in resisting power which indicate its absence. Phosphorus is too, it must be remembered, a constituent of the nucleus, and hence indispensable to the manifestation of vital phenomena. Whatever may be thought of the theories, I have no doubt that phosphorus and calcium, separately and in combination, are useful agents in the prevention and cure of tuberculous diseases.

Freund's[3] observations, too, indicate that Churchill's empirical choice of calcium and sodium for the bases of his hypophosphite mixture was founded upon correct observation, and that the various wonderfully constructed and much advertised formulæ intended to replace it are as unscientific as they are complex.

Sodium phosphate is lauded by Baratoux.[4] He injects once or twice weekly from 45 to 90 minims of a solution containing sodium phosphate, sodium sulphate, each 1 part, distilled water 15 parts, filtered. The injections are followed at first by fever, cerebral excitement, and a feeling of fatigue. This passes off, appetite returns, perspiration lessens, sputa become less purulent, and there is gain in weight. *Sodium chloride* is a necessary food.

Finding the indication therefor in the fever of different stages of phthisis, Jaccoud[5] gives *quinine* or the derivatives of *salicin*. Fever due to fresh eruption of tubercle or the "pyrexia of granulation," having an intermittent or remittent type, some times inverse, or fever

[1] *Wiener med. Presse*, No. 24, 1887.
[2] *Ibid.*
[3] *Loc. cit.*
[4] *Rev. de Thér.*, July, 1887.
[5] *Op. cit.*, p. 164.

due to the development of pneumonitic or broncho-pneumonitic foci from tubercle or other causes (inflammatory fever), he treats with *quinine*. To save the stomach, he gives, not the sulphate, but the hydrobromate of the alkaloid, according to a special routine which ensures the maximum effect in the shortest period of administration. Not less than 16 grains of quinine sulphate or 22 grains of quinine hydrobromate is to be given in twenty-four hours, and the time is to be so arranged that the maximum effect will coincide with the hour preceding the increase or development of pyrexia. The whole quantity, divided into convenient doses, is to be taken within from fifteen to thirty minutes seven hours before the anticipated time of paroxysm. Thus on the first day four *cachets*, each containing 7½ grains (30 grains in all), are given at intervals of ten minutes. If the temperature is not two degrees lower than that of the preceding evening, on the following day 22 grains are given in a similar manner. No matter what the temperature may be, even if there has been no evening exacerbation, 15 grains, in two doses ten minutes apart, are given on the third day. The administration of the remedy is then suspended for two or three days, after which, if necessary, the same plan is followed as before. The pyrexia of early tuberculous deposit is much diminished, or even removed, by using quinine in this way twice or perhaps three times. When due to secondary tubercle-formation near pre-existing tuberculous or pneumonitic foci, the fever is not likely to cease while the local change is in progress; but it is notably controlled, so that the wasting is reduced to a minimum.[1]

In the inflammatory fever attending attacks of congestion, intercurrent bronchitis, pneumonitis, etc., Jaccoud, pursuing the same plan of giving *quinine*, has observed a reduction of nearly 2° F. the first day, and 1° F. the second day, maintained or increased after the smaller dose of the third day. Very little recrudescence of temperature is observed during the two or three days the drug is withheld, and a still further reduction is gained when it is again administered.[2]

[1] I have at times followed this practice of Jaccoud's, but now prefer inhalations of neutral gases and cold applications preceding and during the paroxysm, while giving iodoform and creasote internally. Counter-irritation sometimes reduces fever.

[2] In this class of cases I am also accustomed to give quinine, but lately have employed *cinchonidine salicylate* (gr. xx–xxx *per diem*), or if the stomach will bear it *ammonium salicylate* (gr. v–x, three or four times a day), while placing much dependence upon counter-irritation and the almost continuous local application of cold for two or three days. Sometimes I make no change in the creasote-and-iodoform medication; sometimes I use "Niemeyer's pill" or a modification of it (digitalis, quinine, and opium); sometimes I use a pill of salol, terpin hydrate, and codeine; sometimes a combination of iodoform, digitalis, and codeine. There will be in the present condition and surroundings, or in the previous history and progress of the patient, something that will determine the choice of these or other means; and even the great authority of the observer quoted could not bind me to an invariable routine.

If quinine cannot be given by the stomach because it is not well borne, or because previous dyspeptic trouble or present indigestion leads to a fear of such result, the administration, if to be continued for any length of time, must be subcutaneous. If quinine hydrobromate be pure, 15 grains will dissolve in 75 minims of distilled water: 15 minims thus represent 3 grains, one hypodermatic dose, equivalent to twice that quantity by the mouth. To follow the plan already detailed, five hours before the expected attack three injections are made at one time on the first day, two on the second, one on the third, a period of intermission following. If everything be pure and clean, no inflammation or abscess will be produced, but an erythematous redness over a space rarely exceeding the size of a silver dollar may appear and remain for two or three days. A nodule, however, persists in the connective tissue for two months, or traces of it even for six months. Hence injections are made as far as possible in the trunk or upper extremities, to avoid pain and irritation from multiple nodules in the lower extremities.

The fever of absorption, the so-called hectic fever—which is indeed the true *phthisis* fever, being produced by ulceration or excavation, and absorption of septic products, as well as by tubercle-formation or inflammatory action in the surrounding zone—is the least amenable to therapeutic measures. Jaccoud has never obtained a reduction of more than 1° F. in the evening temperature, and during the interval when medicine is suspended it resumes its former height. It may, however, suddenly cease within twenty-four or forty-eight hours if there is no inflammation in the surrounding zone and the elimination of the diseased tissues be complete. If, however, putrid products continue to be formed, there will be continued septic fever.

Septic absorption may be presumed to exist if the fever be preceded and accompanied by shivering, returning every day at nearly the same hour. Under these circumstances quinine is dropped and *salicylic acid* given. If the latter cannot be taken, quinine is resumed, but the salicin derivative is preferred as a powerful antiseptic, as well as an antipyretic, and by its use may be produced apyrexia, continued for a week or more after the withdrawal of the drug. Indeed, Jaccoud claims to recognize the character of the fever by the therapeutic test—quinine modifying it only, salicylic acid or sodium salicylate removing the cause, and thus putting an end to the effect. If neither complete nor temporary apyrexia be produced, then he believes the fever is not due to absorption alone, but maintained by continued eruption of miliary tubercle or by continued inflammation or ulceration.

He prefers salicylic acid to its salts. It is a more powerful antiseptic, and its effect is more rapid and enduring. When digestion is good, and strength is still maintained, he gives 30 grains the first day, and 22

or 15 grains the second and third days. If the fever is not abated, he again gives 30 grains, and pursues the same plan of treatment at once, or after an interval according to the effect. To patients in a less satisfactory condition he gives but 22 grains on the first day, the same dose or 15 grains on the second day, and 15 grains on the following days, continuing or intermitting the use of the drug according to the effect. In any case if depression of temperature can be observed from day to day he continues the tolerated dose so long as pyrexia exists. Too long continuance when fever is not controlled may bring on serious digestive or cardiac complications. When it is controlled, judgment must be exercised as to the length of the intervals and the frequency and activity of the renewals of treatment. The effect of the remedy is more pronounced the weaker the patient, and care must be taken not to produce collapse. Salicylic acid is powerless in patients affected by alcoholism; it is therefore useless to fatigue them with it. It is given in tablets of $7\frac{1}{2}$ grains each, the whole daily quantity to be taken within an hour if 30 grains or more is to be the dose, or within half an hour if the dose be not more than three tablets. It should be given at least four hours before the expected attack, as its effect, which commences in thirty to forty minutes, is not complete until three or four hours. To diminish the local effect of the acid on the gastric membrane, and also to maintain the renal excretion, which salicylic acid checks in a notable degree, a large glassful of water, containing two or three tea-spoonfuls of brandy, is swallowed with each tablet. If the patient cannot swallow so much liquid, the dose must be spread out over a longer period, the last portions being given four hours before the time of paroxysm. If gastralgia and vomiting are produced, *sodium salicylate* is substituted for the acid. It would be employed in the same way, but in doses of 60 to 90 grains the first day, 45 to 60 grains the second day, 30 to 45 grains the third day, and so on. If this cannot well be managed, hypodermatic injections may be employed; 15 minims of a solution of equal parts by weight of sodium salicylate and distilled water (about 11 grains of sodium salicylate) being the daily dose. Care should be taken not to penetrate into the thickness of the corium, or sloughing may be produced; otherwise no accident need be anticipated if all is pure and clean. It is inadvisable to employ a stronger solution. It should be prepared in small quantities and kept in a blue bottle.

Whatever may be the operation of quinine, the salicylic-acid treatment is employed to combat toxæmia, and hence belongs here for discussion.

Jaccoud lays great stress upon the employment of these agents and upon the particular method of their employment. Though I do not follow his practice in this respect, I have deemed it my duty to present

it fully, for the reason that its author is a great clinician and his observations are worthy of attentive study.

In this condition of septic fever creasote internally and by inhalation, thymol, menthol, eucalyptol, and ethyl iodide by inhalation, hydrogen sulphide and carbon dioxide by rectal injection, are the agents upon which I place most reliance. Hydrogen dioxide internally and inhalations of oxygen and air, or of oxygen and nitrogen monoxide (1 : 3) are often extremely useful. Inhalation of *ethereal oxygen* which B. W. Richardson[1] considers the most useful addition he has made to practical therapeutics, here finds an indication. In a flask with funnel attachment and delivery tube, such as is shown in Fig. 158 (p. 826), are placed 2 ounces or more of ozonic ether. Into this is allowed to drop gradually from the funnel-tube a solution of potassium permanganate, 8 grains to 1 ounce of water. Oxygen gas and ether vapor are given off and may be collected in a rubber bag as shown in the figure, or can be freely inhaled from a suitable mouthpiece attached to the delivery-tube. The combination is anæsthetic, antispasmodic, and antiseptic. Should the ether not be desired, an aqueous solution of hydrogen dioxide may be employed. Any sedative not chemically incompatible may be added.

Inhalation of *ammoniated chloroform* might be used.

Inhalations of ozonized oxygen, as practised by Ransome,[2] must, it seems to me, owe their utility to antitoxæmic powers. I have therefore deferred their mention to this time. Ransome used several methods. The best seemed to be direct inhalation from a Waldenburg gasometer, and under pressure, of pure oxygen, 8 per cent. of which had been electrified into ozone. Surcharging the atmosphere with ozone was too irritating, as might have been anticipated from the researches of Richardson, previously cited. Ransome says that from no other treatment has he seen "such continuous freedom from fever, absence of night sweats, diminution in the amount of expectoration, improvement in appetite and in sleeping power, and such consequent gain in weight."

The serum of dog's blood has been used by Hericourt and Richet,[3] to produce refractoriness to tuberculous infection. The carotid artery of a dog is exposed; a ligature placed above, and a forceps below the point at which the vessel is to be cut; and a sterilized glass canula introduced into the proximal end of the vessel, and connected by a rubber tube with a Pasteur bulb. The forceps is removed, one bulb filled, closed with a plug of cotton, another filled, and so on. After twenty-four hours the corpuscles and fibrin gravitate beneath the clear

[1] *Asclepiad*, vol. iv., 1887, p. 54.

[2] *Medical Chronicle*, vol. viii., 1888, p. 37, *seq.*, and vol. x., 1889, p. 97, *seq.*

[3] *L' Union méd.*, Jan. 31, 1891; *Arch. de Méd. expériment.*, t. i., 1889, pp. 673 *et* 695; *Études expér. et clin. sur la Tub.*, t. ii., 1888, p. 381, *et seq.*

serum. Smaller oval bulbs, containing enough for one or two injections, terminate at each extremity in a fine tube. To fill one it is plunged by one extremity into the serum, which is aspirated at the other. The extremities are sealed by heat. To be sure that the fluid is sterile it is kept for forty-eight hours in a steam-chamber. If still limpid it may be used. To use the serum, one extremity of the bulb is broken and 15 to 30 minims of the fluid taken up into an aseptic syringe. The injection is made in the interscapular region. No accident, local or general, had been observed in any of some fifty operations, unless this term might be applied to itching at the site of the injection. There was no fever, no syncope. Marked amelioration of symptoms is reported, and patients with laryngeal involvement were relieved of their odynphagia, the swollen epiglottis becoming reduced in size and mobile. Appetite and weight improved.

Dogs are immune to tuberculous infection. Rabbits are rendered immune by injections of dog's blood. Without theorizing as to the exact mode of action, Richet believes that the fluid used by him contains a substance or substances chemically antagonistic to the development of the bacillus tuberculosis.

Bacteria, Bacterial Products, and Virus of Disease.

The antagonism between bacteria suggested to Cantani the use of the *Bacterium termo* to fight Koch's bacillus. Solles[1] tried to employ the coccus of erysipelas, and it is a clinical fact that attacks of erysipelas sometimes terminate the course of limited external tuberculous lesions. Neither of these methods is likely to become permanent in practice.

S. G. Dixon[2] of Philadelphia suggested that from the products of the action of the bacillus of Koch on culture mediums, a filtrate might be obtained and so attenuated that by systematic inoculations a change might be produced in living animal tissues that would enable them to resist virulent tubercle bacilli. By subjecting the bacillus to different degrees of moisture, temperature, pressure, and to changes in foodstuffs he produced a virus by which he was able to render guinea-pigs immune to subsequent inoculations with unmodified virus. Robert Koch[3] by similar methods produced a substance, now known as *tuberculin*, that likewise rendered guinea-pigs immune and has been extensively experimented with upon man. It would be unprofitable to discuss it in extenso, but a few paragraphs may be given it. It produces, consti-

[1] *Études expér. et clin.*, Paris, 1888, tome ii. f. i. p. 95.

[2] *Med. News*, Oct. 19, 1889; *Med. and Surg. Reporter*, Sept. 6, 1890.

[3] *Loc. cit.*; see also *Amer. Journ. Med. Sci.*, Jan., 1891. Zuelzer (*Wiener med. Woch.*, No. 10, 1891) prepared from cultures of Koch's bacillus an alkaloid; and Cruikshank and Heroun (*Brit. Med. Journ.*, Feb. 21, 1891) a substance of uncertain composition, but decided toxic power.

tutionally, a septic fever of peculiar type with marked tendency to collapse; and, topically, inflammation, necrosis, and sloughing of the tuberculized tissues. Healing, it was alleged, would then take place, and the patient was expected to become and thereafter remain immune. Cases of wonderful improvement in lupus, joint diseases, pulmonary phthisis, tuberculosis of the larynx, and other diseases were at first reported. Reports of less favorable results are now accumulating. It is acknowledged to be counter-indicated in tuberculosis of the brain and meninges, in extensive laryngeal tuberculosis, and in advanced or extensive tuberculosis of the lungs, as the local reaction may be so severe as to jeopardize life. It may apparently give rise to acute disseminated tuberculosis.[1] It has caused the rapid spread of local ulcerations,[2] the development of pulmonary cavities, produced acute pneumonia of a hæmorrhagic type,[3] hæmoptysis, hæmaturia, albuminuria, myocarditis, endocarditis, and intestinal ulceration and perforation, with peritonitis. In other words, it transforms mild or sluggish processes into violent ones, and increases the fury of active processes. I quote some details of one case as illustrative of its powers for evil. Jarisch[4] injected two milligrammes into a girl of seventeen who had been under treatment a year and a half for lupus exulcerans of the face. Local and constitutional reaction was severe, and within twenty-four hours she died in collapse. "The post-mortem examination, which was made by Professor Pommer twelve hours after death, gave striking evidence of the energetic action of the remedy on all the tuberculous foci. There was swelling with redness in the scars and in the neighborhood thereof, and also around the ulcers in the mucous membrane of the mouth, palate, and epiglottis; and great swelling of the submaxillary and cervical lymphatic glands and of those along the trachea, and beneath the bifurcation of that tube and the roots of the lungs. These glands were caseous, and presented in their interior numerous typical tuberculous foci. There were extensive ulcerated areas in the large and small intestine. In both lungs there were numerous disseminated patches of pneumonitic infiltration, with œdema round about; there was also great œdema of the brain and spinal cord; acute swelling of the spleen, which was 14 centimetres in length, 9½ cm. in breadth, and 4½ to 5 cm. in thickness; and slight

[1] Virchow, Rütimeyer, *loc. cit.;* also case cited in *N. Y. Med. Journ.*, Feb. 24, 1891, p. 187.

[2] *Vide* Tangl's detailed report of progress, necropsy, and histologic examination of A. Fraenkel's case of tuberculosis of the tongue; *Deutsche med. Woch.*, No. 19, 1891, p. 660.

[3] Virchow, *Berlin. klin. Woch.*, No. 2, 1891; Haasler, *Wiener med. Presse*, No. 3, 1891; B. Fraenkel, Körte, *Berlin. klin. Woch.*, No. 3, 1891, and others in nearly all the current journals.

[4] *Wiener klin. Woch.*, No. 50, 1890.

parenchymatous swelling of the liver and kidneys. There were capillary hæmorrhages in the pleuræ, the parietal layer of the pericardium, the thymus, and in several parts of the spinal cord. Among the chronic changes found in the body, in addition to the lesions of lupus and tuberculous bronchitis, there was callous atrophy of the superficial parts of the apices of both lungs; in these spots there was no sign of reaction. There was also slight stenosis of the left ostium atrioventriculare, eccentric hypertrophy of the right side of the heart, and hæmorrhagic pachymeningitis. There was neither stenosis nor œdema of the larynx, and there was no tuberculous formation in the lungs."

The dangers of tuberculin thus seem to overbalance its advantages, and while the time to pronounce irrevocable judgment has not arrived, I desire to emphatically caution against the employment of this or any similar substance. If we are correct in regarding tubercle as a local manifestation of a constitutional defect, or if it be true that bacterial metabolins are the cause of morbid processes, it is obvious that this method of treatment is but bringing flame to the fuel. DaCosta[1] in a clinical lecture said: "I must raise my voice against the use of this agent for diagnostic purposes. Since the knowledge gained by the autopsies made by Virchow, I think it would be cruel to subject the patient to the risk of the dissemination of the disease, ... in order to settle a diagnosis which, in nine hundred and ninety-nine cases out of a thousand, can be settled by other means. . . . . It is rash—criminally rash—to employ it for such a purpose."

An antituberculous "vaccine," consisting of virus attenuated by successive inoculations and cultivations after the methods of Pasteur, has been prepared by Grancher and Martin, who had deposited a sealed paper containing an account of their discoveries in the archives of the Academy of Medicine at Paris on Nov. 19, 1889.[2] This also I consider a remedy more dangerous than the disease. Hilgard Tyndale[3] treated a number of patients by injection of cowpox virus—genuine vaccine lymph; in connection with which treatment may be noticed Lawrence's[4] report of two cases of recovery from both diseases in consumptive patients attacked with smallpox.

Of all these procedures, Tyndale's seems the least objectionable, as we are tolerably familiar with the effects of vaccine virus. Vaccination, however, is not a preventive of phthisis; and moreover Landouzy

[1] *Medical News*, Feb. 21, 1891, p. 220.

[2] *C. R. Acad. des Sci.*, Paris, 1890, t. cxi. p. 332.

[3] *N. Y. Medical Journ.*, Nov. 29, 1890, p. 602. In a personal communication Dr. Tyndale states that he now alternates the injections of vaccine matter with the injection of potassium cantharidate, after Liebreich's method. He selects only cases with active cavities, suppurative expectoration, and persistent high temperature, and combines with the treatment proper food and lung-gymnastics.

[4] *Brit. Med. Journ.*, Jan. 24, 1891.

has been so impressed with the peculiar liability of persons who have had smallpox to contract tuberculosis, that he excludes pockmarked nurses from the hospital wards where tuberculous patients are treated.

The manner in which these substances act seems to be by causing the breaking down of the feeblest tissue-elements—a method not devoid of danger even if it secured its object; for the overloading of the circulation with the products of such necrosis is one of the gravest complications we have to meet in the natural course of the disease. The tendency of the products of life-action to put an end to life, as alcohol to the yeast-plant and carbonic acid to all animals, which was at first supposed to explain the destruction of bacilli, does not seem to apply. A new therapeutic field is opened, but there is no safe path yet laid out; its extent has not been surveyed, and it is full of pitfalls, which seem to be learned only by tumbling therein. That we shall be able to utilize the agents to be placed in our hands by Dixon, Koch,[1] and those who will follow them, I do not doubt, but it seems to me entirely too soon to experiment with these agents upon human lives.

CERTAIN SPECIFIC PLANS OF MEDICATION have been advised, which combine the use of definite agents in definite ways.

Roussel[2] desires to save the stomach for food-purposes, and therefore gives hypodermatic medication only. He injects various substances dissolved in sterilized olive oil, which he finds superior to vaseline for the purpose. The dose being about 15 minims, he uses solutions like the following: eucalyptol, 25 in 100;—turpentine, 15 in 100;—metallic iodine, 2 to 5, eucalyptol, 5 to 10, oil, 100;—iodoform, 2, eucalyptol, 5, oil, 100;—camphor 10, eucalyptol, 10, oil, 100;—paraldehyde, 5 to 10, oil, 100;—crystallized carbolic acid, 5 to 20, eucalyptol, 10, oil, 100.

His favorite method is as follows: Of the solution of *eucalyptol* (1 : 4) 15 ♏ are given daily, say eighty injections in three or four months. This controls septic and febrile conditions.

In addition, as a general antiseptic, eupeptic, and tonic, and as an antagonist to ptomaïnes, *strychnine arseniate* is used, 1 part to 125 parts of sterilized camphor-water. About forty injections, of 15 ♏ each, are given in the course of three months.

To act upon the heart and lungs, and as a diuretic and general eliminant, *sparteine sulphate* is given (5 in 100) at night; some thirty injections, of 15 ♏ each, in three months. To avoid painful contact of solutions with the skin, long platinum needles are used and a transparent

[1] An attractive line of researches is suggested by the comparison of these agents with the medicinal principles of plants. The latter are metabolins also, whether alkaloids, glucosides, or what not. The study of their formation, whether by life or by death, would lead to many advances in knowledge.

[2] *Cong. de la T.*, t. i. p. 682.

celluloid syringe is advised, so that the fluid is seen to be clear. In addition, frequent inhalations are employed of the crude essence of eucalyptus volatilized by means of a water-bath.

Shurly and Gibbes[1] use in conjunction with chlorine inhalations hypodermatic injections of solutions in glycerin of either *iodine* or *gold and sodium chloride*, or both in alternation.[2] They find that guinea-pigs treated with these injections become resistant to inoculation with virulent sputum. Care must be taken that the drugs are absolutely chemically pure or abscesses will result. Potassium iodide

[1] *Journ. American Med. Assn.*, Feb. 21, 1891; *Therapeutic Gazette*, April 15, 1891, reprint.

[2] *Gibbes-Shurly Method.*—Dr. Shurly publishes the following directions for use of the solutions:

"As the chemicals may cause considerable pain to some patients when injected under the skin, the site chosen may be previously treated by the application, for two or three minutes, of a wad of flannel which has been saturated with a mixture of ether and chloroform (equal parts), or ether (two parts), chloroform (two parts), and menthol (one part), or, better still, one of these mixtures may be sprayed upon the part. With many, however, the pain is only momentary, and they will not require such preliminary treatment. The injection may be made at any time of day and without reference to the temperature of the body. The evening will be found generally acceptable to the patient. Although the fluids may be injected at almost any region of the body, the gluteal region will be found preferable on account of the loose cellular and adipose tissue of the part, and because there is less danger of abscess or sloughing of the skin.

"Any hypodermic syringe can be used. Care should be taken to keep the syringe clean. It should be washed with hot water, and then with alcohol or a 5 per cent. solution of carbolic acid, directly after its use. Drawing a little kerosene oil in occasionally will prevent the packing from getting too dry.

"The commencing dose of the iodine solution should be about $\frac{1}{12}$ of a grain, gradually increasing daily until $\frac{1}{2}$ or perhaps 1 grain is reached, when it may be gradually diminished or substituted at once by the gold-and-sodium solution. The temperature is likely to go higher for at least the first week, and as the chemical becomes diffused its effects may be shown in increased mucous secretion from the bronchial tube, sensation of dryness of the throat, redness of the eyes and coryza, characteristic erythema of the skin, diminution of urine or diarrhœa, and loss of appetite. There is loss of weight generally during this period. In susceptible patients these symptoms may supervene after two or three injections only, in which case the gold solution should be used. In a few instances, after thorough diffusion, the characteristic reaction of iodine with starch may be obtained in the urine, and even in the perspiration. If albuminuria occurs, the iodine should be discontinued.

"The chloride-of-gold-and-sodium solution causes less pain than the iodine; in fact, in the majority of instances no pain save the sting of the hypodermic needle. The dosage, like that of the iodine, should be gradually increased, beginning with about $\frac{1}{30}$ or $\frac{1}{20}$ grain, and increasing up to $\frac{1}{5}$ or $\frac{1}{3}$ grain. The smaller doses are better. The more immediate effects noticeable from the larger doses are—vertigo, nausea, sensation of constriction at lumbar region, headache, and lowering of pulse-tension. With many persons the continued use of this solution will cause profuse perspiration, which, however, is soon checked or stopped by lowering the dose or stopping the use of the chemical. When hectic fever is not broken up by these injections, there may be given with great benefit, alternately with the iodide solution, hypodermic injection of bisulphate of quinine from three to six grains."

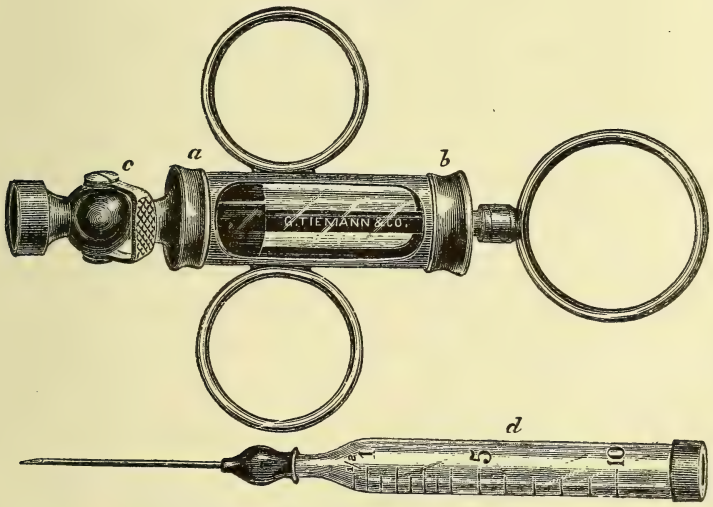
is used to facilitate the solution of the iodine. J. E. Clark[1] publishes tests and directions for the preparation of the solutions.

I have used solutions made by Dr. Clark, which were kindly sent me by Dr. Shurly, and find that they are well tolerated locally, producing but slight irritation if any, and never abscess.

My experience with the method leads me to believe it of decided utility; though I have not satisfied myself that it is superior to other methods, except for hospital patients. That is to say, a few of my hospital patients have done better for a time with this than with other treatment; but not so well as private patients on creasote, arsenic, and iodoform internally. Still, hypodermatic medication offers many advantages in patients that can be kept under control, and the method should be fairly tried.

John Blake White[2] urges the hypodermatic use of a solution of *iodide of gold and manganese* in glycerin. He states that it is difficult to prepare properly, and he therefore advises its purchase from a specified pharmacy in New York. The dose is from 1 to 3 minims of the solution, each minim representing $\frac{1}{50}$ grain of the salt. It is given once a day or at less frequent intervals. White reports excellent results. The syringe designed by him (Fig. 168) is one of the best

FIG. 168.



J. B. White's Syringe for Hypodermatic Medication.

instruments for use in this way, as it obviates contact of the piston with the solution. Platinum needles should be employed.

[1] *North American Practitioner*, Feb., 1891.
[2] *Medical Record*, N. Y., Mar. 21, 1891.

Treatment of Lesions.

General Considerations.—Therapeutically, the lesions of tuberculosis may be divided into two great groups without fixed limits—the *accessible* and the *inaccessible*, sometimes absurdly called "medical" and "surgical." Whether any individual case shall be included in the one or other group depends of course upon the exact location of the lesions, which in one case of laryngeal or pulmonary tuberculosis, for example, may be accessible to topical measures, in another, inaccessible.

It may be laid down as a rule to which there is no exception that when lesions are not readily amenable to treatment, and it is possible to thoroughly extirpate tuberculized tissues without incurring risk of general infection or without exposing the patient to special dangers or losses of function dependent upon the seat of the lesion or upon the character of the operation, *extirpation* is the proper procedure. In some cases a certain amount of risk may legitimately be incurred if a fatal issue or extensive destruction of important structures appears to be inevitable without operation, while interference offers a chance for recovery.

Extirpation of diseased tissues may be effected, as in the case of cancerous and other malignant growths, by *excision* or *evulsion*, including a certain amount of surrounding healthy tissue; by scraping away (*erasion*) all affected tissue, and perhaps some healthy tissue, with a sharp spoon, curette, or other suitable instrument; by the use of the *Paquelin*, *electric*, or other *cautery*, *electrolysis*, or *destructive chemicals*. Of chemicals, *lactic acid* has special application (Krause). *Chromic acid*, *sulphuric acid*, *nitric acid*, *caustic alkalies*, *zinc chloride*, *arsenical paste*, *silver nitrate*, *acid mercury nitrate*, have likewise been used. The injection of *tuberculin*[1] appears to cause, among other effects, necrosis of tuberculized tissues, and the injection of an alkalinized solution of *cantharidin*[2] (*potassium cantharidate* and other products) is said to be equally efficacious (Liebreich). With present knowledge I cannot advise the use of either of these substances, though it is possible that for special limited purposes they may eventually obtain a legitimate place in the therapeutic armamentarium.

When extirpation of diseased tissues is unnecessary, impracticable, or inadvisable, they may be topically treated with certain so-called antiseptic agents, the use of which is also, as a rule, conjoined with the more radical measures. I shall mention not all, but the best of these agents.

Chief among them is *iodoform*, which seems to exert a specific influence upon the tuberculous process altogether apart from any action

[1] Robert Koch, *Deutsche med. Woch.*, Nov. 13, 1890.
[2] *Therap. Monatshefte*, March, 1891.

as a germicide. According to the locality of the lesion, iodoform may be used as a dusting powder or as an ointment, pigment, lotion, or injection in oily or ethereal solution or fatty mixture. Iodoform in ether or chloroform (about 1 : 10) was a favorite of Elsberg's for application to the larynx, and collodion (about 2 parts) was sometimes added to keep in place the fine film of iodoform deposited on the ulcerated surface as the ether evaporated. To be effective these solutions must be quite recently made (within forty-eight hours).

Iodol, thymol-iodine, and other substances proposed from time to time as substitutes for iodoform have not, in my hands, proved efficacious. *Methyl-violet* (pyoktanin) has proved useful in my practice in but one tuberculous case (fistula in ano).

Resorcin has been vaunted by Andeer especially. According to the location of the ulcer, resorcin may be used undiluted or mitigated with starch, bismuth, or the like. If used in the larynx undiluted, it might cause œdema. I have occasionally thought that I saw good results from it, but am not enthusiastic as to its powers.

Hydrogen dioxide (10 to 15-volume solution, diluted one-half or more) is the best of all applications for the purpose of cleansing a tuberculous ulceration, and to some degree promotes healing. Its use is best followed by the application of iodoform.

Iodine is of acknowledged usefulness for internal administration and when absorbed into a scrofulous gland from ointment or other external application; but I have never seen a tuberculous ulceration benefited by its direct application. Horace Green[1] recommended for use in the larynx a solution of iodine (℈j) and potassium iodide (ʒj) in glycerin (fʒj). J. Solis-Cohen sometimes applies to laryngeal tumefactions a weaker solution of iodine and potassium iodide in glycerin, (gr. v *ad* fʒj) to which carbolic acid or creasote (♏iv) has been added.

Mercuric chloride, mercuric iodide, and *potassio-mercuric iodide* have been recommended as parasiticidal applications to tuberculous lesions. I have seen no benefit from their use except as appropriate cleansing applications and dressings in connection with operative procedures.

Creasote and *carbolic acid* have been used in solution as antiseptics and undiluted as caustics. I have no convincing experience of their utility topically except by inhalation. I am therefore of the opinion that upon the tuberculous process *per se* they are without effect.

Menthol in solution (10 to 20 per cent.) in olive oil, almond oil, or liquid petrolatum (liquid vaseline, albolene, benzoinol, or the like) is a useful application, both analgesic and antiseptic, to tuberculous ulcerations of accessible mucous membranes and by inhalation in pulmonary tuberculosis and phthisis.

Bromoform has recently been used by me for topical application on

[1] *Op. cit.*, p. 327.

a sponge or cotton wad to ulcerations of mucous surfaces. I believe that it will prove of great utility. After a brief period of tingling or burning there is a decided analgesic effect, and healing seems to be hastened.

Thymol and *salol* perhaps owe to local action in the intestine their utility in tuberculous diarrhœa.

Camphorated naphthol (naphthol 1 part, camphor 2 parts) has been used by Périer and Reboul[1] for injections into abscesses, serous cavities, the bladder, articulations, and synovial sacs in quantities varying from a few drops in the bladder to an ounce or more in an abscess-cavity.

Acid calcium phosphate has been employed by Kolischer[2] and Freund, especially in the treatment of joint diseases. A sterilized solution containing 6.5 per cent. of acid calcium phosphate, with 1 part in 1000 of free phosphoric acid, was used by injection.[3] For the saturation of gauze that was used in tamponing tuberculous fistulæ and dressing tuberculous ulcers the proportion of free phosphoric acid was increased to 1 in 100, or, if an especially caustic effect was desired, to 2 in 100. Previous to injection the surface of the diseased part was disinfected with mercuric chloride. A platinum needle was used and the injection made deeply into the tissues. If much pain was produced, cocaine was added; 15 minims was the quantity used for an injection. Kolischer believes the method to be especially valuable with children. Some cases recovered quickly, others after tedious prolonged treatment and overcoming of complications. Patients at about adolescence were the most favorable cases. In older persons persistent treatment was not nearly so successful. Deep-seated lesions were not influenced until suppuration had reached the surface, when free drainage and tamponing with the gauze usually proved effective. External tuberculosis in the phthisical was rarely cured. Cold abscesses could be emptied, tamponed, and healed, but the general infection was uninfluenced.

Solution of hydrofluoric acid (1 to 2 per cent.) has been used by Quérin.[4]

While these pages are going through the press Lannelongue[5] has communicated to the French Academies a specific method of treating tuberculous lesions by means of *zinc chloride*. His object is to pro-

[1] *Études expér. et clin.*, t. ii. p. 608.

[2] *Wiener med. Presse*, Nos. 22 and 24, 1887; *Med. News*, Aug. 13, 1887.

[3]

Neutral calcium phosphate,	5 parts;
Distilled water,	50 parts.

Add phosphoric acid until perfect solution results; filter; add—

Dilute phosphoric acid,	$\frac{6}{10}$ part;
Distilled water, to make	100 parts.

[4] *Cong. de la T.*, tome i. p. 618.

[5] *Lancet*, July 11, 1891, p. 94.

duce fibrous change—nature's cure—in the tuberculous nodule. The agent is conveyed not into fungous growths or tuberculous foci, but outside and around them only. Zinc chloride not only sets up an inflammatory condition in the walls of vessels, narrowing their calibre, but there is produced in the altered tissues by transmigration and proliferation a multitude of vigorous new elements, which destroy the bacilli and replace the diseased cells; organizing quickly a firm fibrous tissue, that is found in appreciable quantities within twenty-four hours. The cases reported were of joint disease, but experiments on pulmonary tuberculosis have begun. He uses[1] a 10 per cent. solution of zinc chloride and deposits two or three drops at a determined point. The operation is repeated several times either without removing the needle, its point being directed a little to one side, or by making several punctures. As appears from several references throughout this article, zinc chloride is not a new remedy in tuberculosis, though the method of Lannelongue is novel. Better still, it is rational.

Some detailed attention is to be given certain

Lesions of Special Structures.[2]

Lesions of the Skin.—*Lupus.*—It is the prevailing opinion—doubted, however, by so great authority as Jonathan Hutchinson[3]—that lupus vulgaris is a tuberculosis of the skin, and other cutaneous tuberculous lesions are described. There is even a tendency to include lepra. In the United States lupus is not so common as in Europe.

The treatment of lupus, other than protection and constitutional invigoration, consists in *excision* or *erasion* of the tubercles and other lesions and sufficient of the surrounding tissue, or their destruction by *heat* or *chemical caustics.* Except when heat is used, pain may be prevented by ether spray. To promote healing, *skin-grafting* is sometimes tried.[4] It is not very satisfactory. The best results I have seen have been from the electric cautery freely used, a small patch at a time being thoroughly destroyed by a number of rather deep "hatched" incisions. Lupus of the mucous membranes of the nose, pharynx, and larynx sometimes accompanies lupus of the face, and the same treatment may be employed, except in the larynx, where the electric cautery must be used with caution. *Lactic acid* may then be used as in frank tuberculosis. *Iodoform* seems to do very little good on the skin. R.

[1] *Boston Med. and Surg. Journ.*, July 23, 1891, p. 92.

[2] Tuberculous affections of the ear and of the eye will be considered in the special articles on those organs. Concerning tuberculosis of the œsophagus, stomach, liver, pancreas, or spleen, as primary diseases, too little is known to speak. Addison's disease will be considered elsewhere.

[3] *Lancet*, Jan. 17, 1891.

[4] Tillmanns, *Lehrbuch d. Speciellen Chirurgie*, Leipzig, 1888.

de la Sota,[1] however, has seen recovery take place in every case in which he has used either iodoform or lactic acid in the throat; though he is uncertain whether to attribute the result to his therapeutics or to the "natural evolution of the disease."

Silver-nitrate, arsenical paste, arsenical solutions, zinc chloride (10 to 20 per cent.), *caustic potash, cupric sulphate, carbolic acid, osmic acid* (1 to 5 per cent.), *pyrogallic acid* (1 : 8 of lard), are among the agents recommended for cutaneous lupus, and in some cases these and other remedies are said to have been successful. On the whole, while often mild, the process seems to be inveterate. The whole aspect of the disease is that of a local parasitic infection, yet the bacillus is rarely discovered in the lesions. If the ground of infection be a constitutional defect in reparative force, we can understand why all that art can do is to hasten the exfoliative and cicatricial processes by which Nature secures healing *in loco*, even while the extension of the disease from place to place continues.

The so-called cures reported from the use of *tuberculin* have in some cases proved not to be permanent.[2] In some cases death has occurred under circumstances that can leave little doubt—I at least have none—as to its being the direct effect of the poison.[3]

In recent cases of lupus, where the susceptibility of the patient to tuberculosis—to use that convenient phrase—has not been determined, I should therefore hesitate to inject tuberculin; but in an inveterate case, not involving the throat, which had failed to yield to other measures, in which there existed no visceral involvement, and which by its chronicity seemed to prove the comparative insusceptibility of the patient, I should not now consider the practice altogether unjustifiable; though I would not anticipate a permanent result. Time must show how far and in which direction this opinion will need modification.

Ulcerations not lupoid have been successfully treated by excision of the affected portion and of a sufficient margin of apparently healthy skin, or by curetting and sprinkling with iodoform.[4] Iodoform subcutaneously has been lauded. Skin-grafting has been employed when cicatrization or healing did not proceed satisfactorily. The results vary.

Other methods do not differ in principle from the foregoing. Quérin,[5] for example, applies on absorbent cotton for five or six minutes a 1 or 2 per cent. solution of *hydrofluoric acid*. The application causes pain, but it is easily borne.

[1] R. de la Sota, *Trans. American Laryngological Ass'n*, 1886, p. 1, *seq.*

[2] *Vide* Braun, *Deutsche med. Woch.*, 1891; Jonathan Hutchinson, *Lancet*, Jan. 31, 1891, p. 241; and others in the current journals.

[3] *Vide* Jarisch, *loc. cit.* [4] L. S. Pilcher, *loc cit.* [5] *Loc cit.*

"This sort of cauterization" is repeated every two or three days, a dressing of carbolized cotton being applied in the intervals. In old ulcerated and fungated cutaneous lesions and in abscesses of the neck brilliant results are said to have been obtained.

LESIONS OF BONES AND JOINTS.—*Potts' Disease, Morbus Coxæ, White Swelling, etc.*—Surgeons are not yet unanimously agreed to include all strumous diseases of bones and articulations under the head of tuberculosis, but identification seems to be the prevailing tendency. Discussion of these affections having been made under Scrofulosis, and details of operation belonging rather to professedly surgical treatises, we can here be brief and general. The great question[1] whether radical or so-called conservative measures shall be employed must be decided for each case on its individual merits. So long as there is no visceral involvement and the local disease is apparently quiescent, rest, extension, counter-irritation, hygiene, tonic and antistrumous medication, local injections of iodoform, and allied measures may be given a fair trial. Conservative measures have better prospect of success with children than with adults,[2] with those able to secure proper care and comforts than with the poor. If, however, the general constitution seem to suffer or there is no result from faithful treatment, or special indications are presented by ulcerative and destructive processes *in loco*, some decided operative interference seems to be necessary. I do not refer, of course, to such obvious measures as evacuation of abscesses, with antiseptic irrigation of the cavity, followed by treatment with iodoform, carbolic acid, and the like—concerning which little dispute ought to exist—but to removal of necrosed *débris* and necrosing tissues by scraping, resection, and similar measures, or even amputation. Due precaution must be taken against the possibility of general infection. That death by tuberculous meningitis or involvement of lungs apparently previously healthy has followed these operations seems beyond doubt. But I am far from believing this to be due in every instance to the operation.

Treatment of the field of operation with iodoform prior to interference and constitutional preparation by the internal use of the same drug, as advocated by Verneuil[3] and his pupils, seems, however, to be eminently wise. Thus Barette[4] aspirated cold abscesses, injected ethereal solutions of iodoform in the neighborhood, and a week later opened, scraped, and sutured. One of this author's patients, in whom there was kidney disease, died, however, of iodoform-poisoning.

[1] See interesting discussion on W. Cheyne's paper in *Lancet*, Nov. 15 and Nov. 22, 1890.

[2] *Vide* Pilcher, cited in *Gaillard's Med. Journ.*, Feb., 1887.

[3] *Études expérimentales et cliniques sur la Tuberculose*, t. i. p. 294.

[4] *C. R. Cong. de la Tub.*, i. p. 580, *et seq.*

The use of the thermo-cautery, when practicable, to seal vessels in or beyond the field of operation, seems to me likewise a judicious procedure. Pilcher[1] believes that in any case of osteo-arthritic tuberculosis demanding operation, in which a doubt exists as to the possibility of removing absolutely all the diseased tissue by arthrectomy or excision, the coexistence of lung tuberculosis would add weight to the reasons for having recourse to the more radical operation of amputation.

Tuberculin was at first highly lauded for its action in joint and bone disease, and I am not sure but that it deserved part of the praise received. I would repeat here what was said concerning its use in lupus—that it seems permissible, though I scarcely think advisable, in long-standing cases without pulmonary or other visceral lesion in which all other treatment has failed. Removal of the products of necrosis after preparation of the field of operation by Verneuil's method seems necessary to complete the "cure." Of course hygienic and supporting measures are not to be neglected during and after operations or treatment with tuberculin. Verneuil[2] lays as much stress upon the "post-operative" medical and hygienic treatment as upon the preparation for operation and the skilful surgical management of the wound.

Pulmonary Lesions.[3]—"Pulmonary consumption," the most fatal of all diseases, to judge by mortality statistics, yet, as the practitioners of largest experience have always taught, a disease peculiarly amenable to intelligent treatment, attracts the largest share of attention in the study of tuberculosis. Is pulmonary phthisis always tuberculosis? I do not feel convinced that this is the case. From the earliest days the weight of evidence, clinic and pathologic, in favor of unity has seemed overwhelming to men whose knowledge and experience have entitled them to speak most authoritatively; yet there has always been a dissident party, including men of equal ability and opportunity. Among this party I count my own great teachers. J. Solis-Cohen is decided in his teaching that there is a chronic as well as an acute consumption that is not originally tuberculous. DaCosta's recognition of "a non-tubercular form," it is true, is stated only as a qualification,[4] but it is none the less distinct.

Believing with Rush,[5] that "pulmonary consumption is a disease of the whole system," and that "the tubercles . . . . are the result of the disease, not its cause;" remembering the striking assertion of

[1] *Loc. cit.* [2] *Op. cit.*, p. 671.

[3] See also discussion of Pneumotherapy, p. 857 to p. 877, incl, and of Toxæmia, p. 857 to p. 872, incl.

[4] *Medical Diagnosis*, 7th ed., Philada., 1890, p. 313.

[5] It seems to me that there is tubercle of the lung, arising without inflammation, that either heals or passes into phthisis, and inflammation that passes into phthisis and may or may not be associated with tuberculosis.

Graves, "that many persons would die of phthisis, even supposing they had no such organ as the lung,"[1] I have endeavored to emphasize those invigorating measures which combat general degenerative tendencies, rather than to lay stress upon the treatment of local morbid processes. At the same time, we cannot ignore the many dangers dependent upon local morbid processes, and must endeavor to avert them by treatment partly systemic, partly local, but designed for local effect. Some classification is necessary, but the general plan of this work and of this article, and what I still believe to be the imperfection of current knowledge, render classification difficult and unsatisfactory.

Without attempting to discriminate between tuberculous and non-tuberculous phthisis, I shall recur, as most convenient for present purposes, to the divisions already suggested, based upon the tendencies of the morbid process to limitation in time or in space.

First, then, is that process with *little or no tendency to limitation*, beginning with apparent acuteness, often as the immediate sequel to an inflammatory affection of some portion of the respiratory tract—the *phthisis florida* or "galloping consumption" of authors—which, as already stated, is here discriminated from acute disseminated tuberculosis.[2]

I cannot recall a single instance in my own practice of recovery from this form of the disease; but perhaps our definition regards only the more rapidly fatal cases of a larger group that should include as well the next variety—that, namely, which exhibits *tendency to limitation in time, but not in space.* This latter class includes cases from all of the received divisions, and cannot be wholly identified with any of them. I have seen many recoveries from the acute attack, leaving of course more or less badly damaged lungs. In both these varieties the tendency to rapid extension of lesions is the indication that must guide therapy. This tendency is increased by the fever which is an invariable accompaniment, and perhaps result, of the local processes. The subjects are, as a rule, young and with strong hereditary predisposition to phthisis—an inheritance often absent from the adult subjects of acute miliary tuberculosis. In such cases I believe that inflammation plays as large a part as tubercle-formation—not inflammation in the ordinary sense, as in a sthenic pneumonia; but a specific inflammation, the characteristic of which is the immediate breaking down of the new-formed tissue-elements, which lack even sufficient vitality to form defined tubercle. The question of the possibility of bringing about recovery is a question of power—(1) to bring up the vital forces to the

[1] *Op. cit.*, p. 524.

[2] DaCosta (*op. cit.*, p. 340) describes one group of cases of this kind as differing from acute miliary tuberculosis.

point of resistance; (2) to calm the nervous system in order to reduce the combustion of fever (morbid, as contrasted with normal katabolergy) and the morbid reproduction of non-viable cells (destructive or exhaustive, as contrasted with reconstructive, anabolergy); (3) to modify the morbid energy or divert it from the lung by reflex impression (revulsion or derivation); (4) to avert and combat toxæmia. In my own practice the first indication is sought to be fulfilled by *rest*, *food*, and the administration of *alcohol*, *quinine*, and *strychnine*, as in the case of any other acute fever presenting similar phenomena. A word must be said concerning rest. The patient is to be kept quiet, but not housed unless this be unavoidable. A hammock swung in the open, or a steamer-chair upon a porch or balcony, is preferable during the day, to bed and room. When confinement is unavoidable the attempt should be made to have a day-room and a night-room. The best of ventilation must be secured, and inhalations of *oxygen diluted with nitrogen monoxide* are often advisable, not for any specific usefulness, but as a convenient means of getting a renewal of vitalizing (*i. e.* unbreathed) air in the exigencies of confinement. *Ethereal inhalation of oxygen* is of use in the same way, and also helps to allay cough.

The second indication is met by the application of *ice-bags* over the heart and chest, and if necessary to the head and cervical spine, being guided somewhat by the temperature, which should be kept below 100° F. if possible. In addition, *opium or codeine sulphate* is given in sufficient dosage, being guided somewhat by the effect upon the cough and dyspnœa. That is to say, the attempt is made to subdue the frequent ineffective cough,[1] which seems due to nervous irritation; and to quiet the excessive rapidity of breathing, often out of all proportion to the extent of pulmonary lesion. When neither cold nor opium preparation effects this object, *diluted hydrocyanic acid* (gtt. i–v), *diluted hydrobromic acid* (gtt. xv–xx), *ammonium bromide* (gr. v–xxx), *coniine hydrobromate* (gr. $\frac{1}{200}$ to $\frac{1}{60}$), or *hyoscyamine sulphate* (gr. $\frac{1}{200}$) is used with sufficient frequency; the drug being temporarily withheld so soon as the symptoms of irritation subside. I have not used chloral hydrate, but—the heart being reasonably strong—I would not hesitate to do so if other measures were not fairly efficacious. Many cases, especially those with exceedingly rapid heart, will be benefited by digitalis, and the "Niemeyer pill" is peculiarly applicable.

Digitalis not only quiets and strengthens the heart, but seems to help to reduce temperature and relieve dyspnœa. Beddoes's laudation of this drug was perhaps extravagant if applied to ordinary chronic pulmonary tuberculosis; but a study of his reported cases seems to indicate

[1] Beddoes called attention to this cough as one of the early diagnostic points, and remarked on the infrequency of its description in the literature of his day. Even now not enough stress is laid upon its pathologic and therapeutic significance.

that his most remarkable successes were obtained in early or late cases presenting the phenomena now under consideration. If I do not urge digitalis more enthusiastically, it is because the ice-bag over the heart seems to produce effects very similar to those of the drug, and I would always spare the stomach when possible. *Fluid extract of quebracho* (fʒj every half hour to every fourth hour) sometimes relieves dyspnœa.

Soothing inhalations, especially *carbonic acid*, *nitrogen monoxide*, *chloroform*, and *ethyl iodide*, help to subdue nervous irritation in general. *Ammoniated chloroform* might be tried. Nitrogen monoxide sometimes reduces fever, and "suboxygenated air," after the method of Valenzuela, might be tried for a similar purpose. It was in this class of cases—"florid consumption"—that, as he himself points out, Beddoes did most good with *hydrogen* inhalations. The pathetic request for "more of Dr. Beddoes's breath," made by the young man whose case is detailed in his letter to Darwin, is convincing testimony to its at least palliative efficacy. I saw some reduction in temperature from *gaseous enemata* after the method of Bergeon, which in these cases was probably due to the carbonic acid, according to Beddoes's reasoning. Mays[1] strongly urges antipyrin, acetanilide, and phenacetin in conditions like those we are now considering, but in the limited trial I could induce myself to give these agents they seemed to be of little benefit. Still, I would not hesitate to use *phenacetin* or *acetanilide* in small doses for limited periods, if hyperpyrexia, uncontrollable by the application of cold and sedative measures or the agents directed against toxæmia,[2] indicated great morbid excitation of nervous centres.

The third indication is fulfilled by *counter-irritation*. Croton oil, iodine, cantharides, thermo-cautery, Vienna paste, setons, have been employed. I preferably use *cantharidal collodion*, making a succession of small blisters about the size of a silver half dollar over the affected regions of the chest, and keeping at least one constantly sore. I am strongly inclined to revert to the use of the seton. *Thermo-cauterization* may be conveniently and efficaciously done after the method described by Schoull,[3] who advises (not, however, in this special connection) punctate cauterization with the thermal point, repeated regularly once or twice a week. Pain is prevented by the local use of methyl chloride. He believes this procedure to be less irritating and less exhausting than the use of iodine, croton oil, or blister, and equally efficacious. The points of cauterization are made in rows at one application, and "intercalated" in new rows at the next operation.

The fourth indication, being of a more general nature, we have

[1] *Med. and Surg. Rep.*, Aug. 11, 1888, p. 164.

[2] See Jaccoud on the treatment of pyrexia, cited on page 867, *et seq.*

[3] *C. R. Cong. de la T.*, t. i., p. 674.

already considered under a special head,[1] and so will we deal with special symptoms, such as hæmoptysis, diarrhœa, night-sweats, and cough, common to all groups.

Despite all we can do, some of these cases, forming the group of "galloping consumption," progress more or less steadily to the fatal termination. I have seen it postponed by many months; I have seen it delayed astonishingly from week to week and from day to day; but I have never seen it averted. Nevertheless, I hope that even this may not be beyond attainment in the progress of science.

Other cases soon give evidence of amenability to treatment. The fever gradually—though somewhat irregularly, and with alarming recrudescences—subsides; the sweats cease; the cough mitigates; the restlessness disappears; paroxysms of dyspnœa become less and less frequent; strength and appetite return; the violence of local destruction indicated by auscultatory phenomena is arrested; and dry tubular or cavernous breathing, without râles or with but few moist sounds and some pleural creaking, indicates that the extension of the acute processes has been checked.

Convalescence is then to be skilfully managed on the lines already laid down, and the hope may be entertained that at least temporary recovery has been reached. The patient must for a time be kept under close observation, whether at home or abroad, and carefully protected from climatic changes. The treatment appropriate to chronic phthisis must be maintained, and if renewal of active morbid processes is detected measures are to be taken accordingly. For modification of the local morbid conditions nothing is better than the administration three or four times a day of a combination of *ammonium carbonate* and *ammonium iodide*[2] (āā. gr. v) in glycerin and water, the taste being covered and the stomach soothed by the addition of *erythroxylon fluid extract* (fʒj), which is also a good tonic. *Ammonium chloride* (gr. x–xv) may sometimes be added to this mixture, or if there be much irritative cough, *ammonium bromide;* and *cherry-laurel water* or *syrup of wild cherry*, with or without an additional minute dose of *diluted hydrocyanic acid*, may be made the vehicle.

It is possible that antiseptic and astringent injections into cavities or into the lung-parenchyma might be of use in these cases toward the period of convalescence. I have tried it, but have not been satisfied that the improvement noted was due to the injection, as I have not felt like giving up other treatment meanwhile. Surgical measures I deem counter-indicated by the rapidity of the destruc-

[1] Measures to favor elimination, inhalations of the "halogen" or "resin" group of agents, and the internal administration of creasote and iodoform constitute my usual practice.

[2] *Vide* Bartholow, *Therapeutics*, etc., articles "Ammonium" and "Iodine."

tive process during the activity of pathological changes; and after quiescence they are unnecessary. When general convalescence has been sufficiently established, but the persistence of moist sounds at or near the area of former involvement indicates the persistence of destructive, if less active, inflammation, a sea-voyage or prolonged if not permanent residence in a region of pure, but not too highly rarefied, atmosphere is indicated. Experiment may have to be made before it can be determined whether dryness of air or equability of temperature is most to be desired. I have not accumulated sufficient experience in this particular to venture a decided opinion. Some of my patients have done well in the Adirondacks, some in the Riviera; some have passed the winter safely in Lakewood, New Jersey. A region both dry and warm, like parts of Egypt, would seem best; and this, so far as I can gather from Williams, whose classification of cases is different from the present, is the opinion of that experienced authority. Southern California also offers some eligible resorts. Those who are unable to change their residence or regulate their work in accordance with their enfeebled condition have but slender prospect of permanent recovery, though they may have many years of active and useful life. The period of quiescence varies. I have seen it prolonged so many as eight years. I have known it to be less than six months. If the process is confined to one lung, or if, in case both lungs are invaded successively or simultaneously, the area in each is small, the patient may recover—that is to say, reach the quiescent stage—again and again. If, however, both lungs should be extensively involved in the caseous destruction, or tuberculosis of the disseminated variety should supervene, the second or third attack may be fatal.

The injection of *tuberculin* early or late in a case of this tendency would undoubtedly be fatal. On the other hand, as already suggested, *intrapulmonary injections* during the quiescent stage, or rather toward the time of cessation of the acute process, seem to have done good in a few cases, and are, I think here indicated, though my own success with them has not been great. *Iodoform* in ether or oil, and *iodine* and *creasote* [or carbolic acid], in glycerin, seem to me the best solutions for direct injection. I have used the latter more frequently. *Zinc chloride* (Lannelongue) is to be tested.

Intrapulmonary Injections.—From time to time injections into the pulmonary tissues have been practised, either with the hope of reaching and disinfecting a cavity (Mosler) for improving the condition of its walls, and if possible bringing about adhesion (Pepper), or simply for effect upon the tuberculized tissues in general, before cavity-formation (Robinson). Mosler,[1] having inserted a canula into a superficial cavity of the right apex, injected 20 ccm. (*circa* f℥v) of a weak solution

[1] *Berlin. klin. Woch.*, 1873, No. 43.

of *potassium permanganate.* Pepper,[1] through a small canulated needle three inches long, injected from ♏iv to ♏xxv of a weak solution of *iodine* (*liq. iodi comp.*, from 1 in 15 to 1 in 5). The needle was introduced from an inch and a half to two inches, according to the comparative fleshiness or emaciation of the patient. Beverly Robinson[2] used, after Pepper's method, solutions of *iodine* and of *carbolic acid;* John Blake White,[3] similarly, a mixture of *iodine* and *carbolic acid* with *morphine* and *atropine*;[4] V. Y. Bowditch,[5] the formula of White. Rosenbusch used *creasote* in olive oil. Gougenheim[6] employed a solution of *mercuric chloride* (1 : 2000 to 1 : 500). Shingleton Smith[7] at first used *iodoform;* later, on the suggestion of Cochrane of Shomond, Wisconsin, he injected a saturated solution of *camphor* in *carbolic acid.*[8] Renzi used a solution of *iodoform* in olive oil. Lépine and Truc[9] used a 2 per cent. solution of *creasote* in alcohol. Satterthwaite[10] calls attention to the importance of employing solutions that will not leave a granular deposit. Before inserting the needle the skin should be frozen with a spray of ether, rhigolene, or methyl chloride, though the application of ice may answer. The injections have usually been made either in such a place as seemed most likely to reach a cavity, or anteriorly in the second interspace on either side, midway between the mammillary and anterior axillary lines. According to the apparent effect, the injections have been repeated daily or at greater intervals, even of several weeks.

According to Robinson[11] and Satterthwaite, the axillary region high up in the first, second, and third interspaces, with the arm elevated at a right angle to the chest, is the best region from which to make injections into apical cavities. Punctures can, however, be made with ease and safety in the first, second, and third interspaces, anteriorly, on a vertical line with or outside of the nipple, but not inside of this line.

Pain and cough are sometimes caused by this procedure, but neither, as a rule, lasts very long. Hæmoptysis is rare and inconsiderable.

[1] *Amer. Journ. Med. Sci.*, July and Oct., 1874.
[2] *Philada. Med. Times*, Nov., 1884; *Med. Record*, Jan. 10, 1885.
[3] *N. Y. Med. Record*, May 22, 1886.

[4] ℞. Atropinæ sulphat., gr. ½;
Morphinæ sulphat., gr. iv;
Tr. iodi, ʒiij;
Acidi carbolici puri, gtt. xx;
Glycerini, ʒss;
Alcohol (20–30 per cent.), ʒss.—M.
Sig. Ten to thirty minims to be injected into the pulmonary cavity.

[5] Reprint, Boston, 1889.
[6] *Lyon Méd.*, May 3, 1885.
[7] *Trans. Int. Med. Cong.*, Washington, 1887, vol. i. p. 195.
[8] *Bristol Medico-Chir. Journ.*, Dec., 1888; *Medical Chronicle*, 1889, vol. x. p. 152.
[9] *Lond. Med. Record*, Jan. 20, 1888.
[10] *Med. Record*, N. Y., 1885, Jan. 10, p. 49.
[11] *Loc. cit.*

Among exceptional results, brief syncope, dyspnœa, transient subcutaneous emphysema, and temporary rise in temperature, have been reported. Smith[1] records the following list of accidents: "Acute suppurative bronchitis, fatal in forty-eight hours; acute pleuritis (two cases), speedily recovering; pneumothorax, temporary and harmless; intense pleuritic pain lasting for hours and requiring full doses of morphia; violent fits of coughing. (Iodoform poisoning and hæmorrhage from the lung were observed by Dr. A. Ransome.)" He states that care should be taken to inject the fluid into the pulmonary tissue and not into the pleural cavity, and that he would not employ the method when both lungs are implicated or after the disease had reached a hopelessly advanced stage. Pepper[2] concluded that "the cases best adapted for this local treatment are those where a single small superficial and circumscribed non-tuberculous cavity exists; but that even when there is implication of the rest of the lung, or incipient disease of the opposite lung, some benefit may be expected." He is inclined to consider "a demonstrable amount of healthy tissue between the cavity and the thoracic wall" as a counter-indication.

Although the reports of these and other competent observers seem to show more or less improvement in nearly all cases, and quite remarkable improvement in some cases, I have not been sufficiently encouraged by my own experience to persist in the practice.

Vigneron[3] found intrapulmonary injections not only useless, but even harmful; one patient died in four hours from pneumothorax.

Riva[4] prefers "pulmonary inundation," injecting from $2\frac{1}{2}$ drachms to $6\frac{1}{2}$ ounces of solutions of *corrosive sublimate* or *camphorated chloral*. To enable patients to bear the injection only 15 minims must be thrown in per minute. Richardson[5] would use *hydrogen dioxide*, and even before cavity-formation would throw small quantities into the consolidated or softened tissues, adding tannin to prevent hæmorrhage.

"There would be no danger from injecting, by needle puncture through an intercostal space high up in the fore part of the thorax, four ounces of the thirty-volume solution, rendered neutral and warmed to the normal blood temperature. The water might produce a little œdema, but it would soon be picked up and carried into the circulation by the capillary vessels."

Richardson[6] has devised a special "automatic syringe" for "subpulmonary" and subcutaneous injections of hydrogen dioxide. "It is a small graduated instrument having a feeding-tube for charging it

[1] *Loc. cit.* [2] *Amer. Journ. Med. Sci.*, Oct., 1874, p. 342.

[3] *Études expér. et clin.*, t. ii. p. 605.

[4] *Italian Society of Internal Medicine*, 1888, cited in *Med. and Surg. Reporter*, Dec. 1, 1888.

[5] *The Lancet*, Mch. 28 and April 4, 1891. [6] *Loc cit.*

on one side, and an exit-tube for discharging it on the other side. When both tubes are in place the mere act of working its piston up and down fills and empties it." It is fitted with needles of different sizes, and will receive and deliver in uninterrupted current from ten minims to four ounces, without danger of entrance of air.

Processes more or less limited in space, but with comparatively little tendency to limitation in time, are the most common, and might be subdivided into almost endless varieties. In its full scope this division includes lupus and scrofulous glands, many cases of bone disease, and other localized lesions. So far as concerns pulmonary lesions, the principal varieties are (1) fibroid phthisis, (2) a tuberculous disease ordinarily called chronic phthisis, and (3) that group of cases concerning the nature of which there is still room to doubt—the cases, namely, that begin as bronchitis or pneumonia (lobar or lobular) more or less frank and more or less limited, and eventuate in caseous degeneration with cavity-formation. It seems to me that Niemeyer, while perhaps including too much in his classification of inflammatory or catarrhal phthisis, was right in what Flint calls his "absurd statement," that the great danger in such cases is that of tuberculosis becoming engrafted upon the original affection. And it might be said with equal truth that in the non-inflammatory cases primarily tuberculous the great danger is that they may become phthisical. I have now under my care a patient without hereditary tendency to tuberculosis whose disease, so far as I can judge the history antecedent to my observation, began as an acute pleuro-pneumonitis due to cold, the true condition passing unrecognized in its acute stages. This patient's sputum contains from time to time tubercle bacilli, and she has had hæmoptysis, yet the physical signs, limited as they still are to the right side, and originally to the base, are those of chronic pneumonia with pleural thickening and adhesion. I have deemed the case important enough to have the benefit of the opinion of the best qualified observer in America. DaCosta says of it: "In the absence of bacilli I should not call it tuberculous." Whether this woman recover (her improvement indicates that she may), or whether she does not recover, even the later discovery of tubercle, clinically or otherwise, would not make me look upon tuberculosis other than as an epiphenomenon in this case.

In all cases of this division the comparatively hopeful prognosis is based upon the slowness with which local lesions extend; and in this same fact we find our indications for therapy. It indicates the possession of a certain amount of reparative force, and enables us by our general invigorating treatment first to increase the tendency to limitation in space, and finally to bring about that complete constitutional change which will limit the process in time as well. Local treatment

is also of great assistance, though rather in averting toxæmia and in preserving tissues surrounding the seat of local disease than in influencing the latter in cases of actual tuberculosis; while in cases of catarrhal disease, or in what may, while awaiting a better term, be called "scrofulous inflammation," considerable influence may be exerted upon the local conditions.

Three principal varieties, two of which may be either tuberculous or inflammatory in the beginning, demand some separation in discussion. First and most common is a form, that of which Fowler has well described the "line of march," which spreads slowly from one to another of the affected areas, involving for the time a comparatively small space and giving rise to but moderate secondary constitutional symptoms until late in its progress, when both lungs may be extensively implicated. Cavity-formation may be long delayed, and cavities are thus rarely amenable to direct measures, owing to the extent of disease at the time of their appearance. This variety I think, is most often tuberculous from the beginning.

Next, and not at all uncommon, is that variety with early cavity-formation and persistent though intermittent activity, but quite limited spread. One case that I have in mind has a large cavity in the right middle lobe, with but moderate consolidation at the left apex, and almost no other lesion detectable. In these cases secondary constitutional symptoms are early and severe, and often, after being kept in check for a time, the local activity and systemic disturbances will recur markedly, to be soon brought under control again without much extension of lesion. During the exacerbation the patient will lose flesh rapidly, and pick it up again as rapidly during the remission. This variety, I think, is frequently non-tuberculous in the beginning.

The third variety is chronic fibroid phthisis.

All these seem to be capable of compounding and combining with one another in a way that renders nosologic and pathologic discrimination the difficult matter it confessedly is; but clinically the tendencies mentioned are often so distinct as to afford definite therapeutic indications. The termination of the first and third varieties is often by a process simulating acute miliary tuberculosis, while the second variety terminates with symptoms resembling those of florid consumption; though this is far from being an invariable rule. I have seen patients, sometimes but a few days before death, who have then presented enormous cavities in one or both lungs, and who have given me a history so exactly resembling that of the second class of cases here mentioned that I have inferred they were of the same nature. In these patients the final breakdown has been rapid, the earlier history apparently one of a succession of attacks of softening in a limited area.

We have already discussed at length the general protective and invigorative treatment. It applies to all varieties.

In the First Class of Cases—which includes ordinary chronic tuberculosis of the lung and chronic "scrofulo-pneumonic phthisis," beginning as an apex catarrh—*cod-liver oil*, *hypophosphites*, *arsenic*, *strychnine*, *iodoform*, and *hydrogen dioxide* are among the most useful agents for internal administration. In "caseous pneumonia" *ammonium iodide*, as advised by Bartholow, is an especially useful remedy. In some cases *iron* is usefully combined with the other agents mentioned.

Change of residence is of great assistance, but if it cannot be managed artificial climatic measures may be employed, especially *inhalations of compressed air*.

Counter-irritation over the seat of the lesion is useful, but more so in the catarrhal than in the tuberculous cases. A succession of flying blisters is the best method.

Fever is slight or often absent until secondary toxæmia arises, when it is to be met on the principles already laid down in discussing the treatment of toxæmia and the management of galloping consumption; *creasote* being the most useful agent for internal use. *Inhalations* of *terebene*, *eucalyptol*, *creasote*, and the like are often of benefit. If there be a cavity, *terebinthinate*, *iodic*, or *sulphurous inhalations*, and *sulphurous rectal injections*, are among the most useful measures. *Counter-irritation* may now be employed over the site of the cavity, or *injections* be made into its interior or into the pulmonary tissue in its neighborhood.

In Cases of the Second Variety there is usually toxæmia from the first, and often antecedent inflammation. Here *creasote* and *iodoform* internally, or *creasote* and *iodine* by hypodermatic injection, are the preferable agents for constitutional effect. Under circumstances previously detailed, *arsenic*, *iron*, *ammonium salicylate*, and *quinine* will be useful. If there be high fever, *rest* must be enforced and the *ice-bag* employed if necessary. Active *counter-irritation* over the cavity, *antiseptic inhalations*, *rectal injections of carbonic acid and sulphuretted hydrogen* are beneficial. After active suppuration has been controlled, *inhalations of compressed air* or of *oxygen* or *ozone* should be instituted. *Climatic change* is useful, but patients do surprisingly well without it.

When the cavity is single and localized, direct injection may be of service, but I believe there are more often a number of small aggregated excavations, which later coalesce, and that it would be difficult to reach them all.

Surgical Treatment of Cavities would be useful in this class of cases, if in any, but it is probably unnecessary in many instances, as recovery, if it is to occur, will occur without operation. Thus, in one case of this

description, discouraged by the renewed expectoration of pus which—after cessation of all pulmonary symptoms and complete disappearance of auscultatory phenomena indicating active excavation—supervened on an attack of localized pleuro-pneumonitis, I was about to propose to the patient opening and drainage of the cavity; but upon consulting with Dr. DaCosta he advised waiting—with justification of his opinion by the event. Tapping and drainage of phthisical cavities was advocated, and it appears to me performed, by Barry;[1] and according to Hastings[2] of naphtha fame, was done by Sir Henry Marsh, Ramadge,[3] and some unnamed continental surgeons. Storks performed the operation for Hastings on two patients. One received marked benefit; the other, being too far advanced, died in fourteen days. Barry had called attention to the existence of adhesions over a cavity as doing away with the fear and danger of inducing pneumothorax; and with simply the addition of antiseptic methods, Storks's[4] operation seems the best, if nothing more than drainage be contemplated. "It being decided in which intercostal space the opening is to be made, an incision nearly two inches long should be made with a narrow, straight bistoury along the upper border of the inferior rib of that space down to the intercostal muscles; the instrument [or canula] should at once be cautiously pushed into the cavity, and the consequences carefully observed; and should nothing forbid, the incision should be prolonged to the extent of an inch or more. . . . . After the incision is made a piece of a full-sized elastic gum catheter is to be introduced along the wound into the cavern, and retained in its position by a piece of ligature tied round the end (which should project a quarter of an inch beyond the external wound), and the ligature should be secured by strapping." Mosler's first procedure has been mentioned. In another case of his with Hueter, a long incision was made along the upper border of the third rib, commencing about $5\frac{1}{2}$ cm. from the right border of the sternum. After dilatation of the incision through the muscle, the wall of the cavity was gradually opened with a suitable pair of forceps. A pretty large silver drainage-tube was inserted. Powell and Lyell[5] entered the cavity first with a fine trocar, afterward enlarging the opening with a larger one. They split the end of the drainage-tube and fastened it to the edges of the wound with sutures. Antiseptic irrigations may be practised (for which purpose *hydrogen dioxide* seems to me the best agent), and antiseptic dressings should be employed. *Iodine*, *iodoform*, or other agent may be introduced, and allowed to remain for effect upon the lining of the cavern. Hæmoptysis or hæmorrhage has been controlled by styp-

[1] *A Treatise on Consumption*, Dublin, 1726; *A Treatise on Three Different Digestions, etc.*, London, 1763.

[2] *Op. cit.*, Appendix, p. 227.

[3] *Vide*, Ramadge, *op. cit.*

[4] *Op. cit.*, p. 251.

[5] *Med.-Chir. Trans.*, London, lxiii., 1880, p. 334.

tic injections (*Monsel's solution, ferric chloride*, or *tannic acid*), or packing with antiseptic or styptic gauze. As a rule, basic cavities are deemed more suitable for operation than apex-cavities, which can secure drainage through the bronchi. Still, the case of Neve,[1] among others, is illustrative of what can be gained by opening apex-cavities. In this case the patient was haggard and emaciated; the violent cough and profuse expectoration had lasted a year. There was supposed to be a large single cavity in the upper and anterior part of the right lung; the right middle and base were healthy, and there was condensation of the left apex. After failure of other treatment to produce much effect in three weeks, an incision two inches long was made close to the right nipple; the fourth rib was resected; and, the pleura being found adherent as expected, the finger was forced upward and inward in the direction of the cavity. Two small cavities were found, the tissues being hard, but friable. A large drainage-tube was passed into the lung, and the wound closed by a pad of gauze and a sawdust bag. Daily irrigations were made with corrosive-sublimate solution, followed by injections of pure oil of eucalyptus through the drainage-tube. The pad was kept moist with creasote and eucalyptus. The drainage-tube was removed after the fourth week. The chest round and above the wound contracted, but the sinus remained open. All symptoms were mitigated, and general improvement had lasted for many months at the time of report.

In connection with the injection of tuberculin, operations upon the lung have been performed by Sonnenburg,[2] with the idea of thoroughly destroying the necrotizing tissues by means of the thermo-cautery. To reach an apex-cavity he makes an incision parallel with the clavicle, and a thumb's breadth beneath it, from the manubrium to within two fingers' breadth of the coracoid process. If not carried too far, the subclavian artery and vein will not be exposed. After laying bare the first rib, the perichondrium and periosteum are incised longitudinally, and carefully lifted with an elevator. In this way the intercostal arteries are avoided and the intercostal muscles pushed aside. A bow-shaped piece is removed from the rib, so that a thin superior bridge remains. The neighborhood of many great arterial and venous trunks beneath the sterno-clavicular articulation requires great care upon the part of the operator.

When apex-cavities exist there are usually adhesions of the apex, principally at the level of the second rib; hence there is little danger of pneumothorax: A small puncture through the pleura into the cavity is made with not too small a trocar or hollow needle, and the pus removed. Then, with a pointed thermo-cautery exactly through the

[1] *Lancet*, 1887, i. p. 263, cited in *Med. and Surg. Reporter*, March 12, 1887.
[2] *Deutsche med. Woch.*, Nos. 1 and 6, 1891.

punctured opening, the pleura and the lung-tissue are slowly burned to the cavity; the Paquelin cautery must not be allowed to reach a greater heat than cherry red. The dressing is with iodoform tampon, changed daily. Small cavities like pockets are opened in the same manner, and gradually converted into one large space. In the cases reported very little constitutional disturbance or local complication was noted, except in one patient, in whom the fourth rib was resected, adhesion was not found, and the operation could not be finished on account of pneumothorax. Even in this case, adhesion soon took place and the dyspnœa disappeared. The patient died, however, some time previous to Feb. 5, 1891, the date of the last publication. Of four other cases, three were reported "cured."

Tillmanns[1] showed at the Congress of German surgeons in Berlin in 1890 a patient whom about two years previously he had "completely cured of severe tuberculosis of the left pleura and left lung" by extensive resection of the front part of the left chest-wall. After the operation the lung contracted in such a manner that by a second operation the remaining tuberculous area was completely removed. The pleura was energetically scraped with a sharp spoon and stuffed with iodoform gauze. A skin flap was finally transplanted according to the method of Thiersch, obliterating the cavity caused by the previous procedures. The patient having only one lung, but that a healthy one, attends to his business as a merchant and is in blooming health.

When one lung is uninvolved, or at least with but slight condensation, and suppuration in the other lung fails to be controlled by ordinary measures, I am becoming more and more inclined to advise operative procedure of such nature as the condition may indicate.

Lung-surgery is still in its infancy, but as the next century dawns may make as rapid and wonderful progress as brain-surgery has done in the last decade, and abdominal-surgery just before.

The Pleura is often involved in inflammatory processes connected with pulmonary tuberculosis and phthisis, and very frequently is the seat of tuberculosis in connection with tuberculosis of the peritoneum. Many authors are inclined to look upon nearly all acute pleurisies as tuberculous. V. Y. Bowditch,[2] however, recently studied the subsequent history of a number of cases of acute pleurisy, and found that only a moderate proportion developed phthisis. Dry pleurisy especially is regarded by Sir Andrew Clark[3] as a forerunner of pulmonary tuberculosis, and double pleurisy and recurrent pleurisy are nearly unanimously called tuberculosis. The question, however, is by no

[1] *Brit. Med. Journ.*, June 14, 1890.
[2] *Trans. Amer. Climatological Ass'n*, 1889, p. 1, *seq.*
[3] *Lumleian Lectures*, 1885.

means settled. One of my patients, daughter of a "consumptive" father whose case lasted forty years, and was probably not tuberculosis, has had in twelve years four attacks of pleurisy, once on both sides. She has always made a good recovery, and although she has a chronic consolidation of a portion of the lower right lobe, the result of a pleuropneumonitis, she has not developed pulmonary tuberculosis. Is there here a persistent focus of tuberculosis in the pleura, from which inflammation is lighted now and again, but quickly becomes limited?

In this case the treatment consists of good nourishment and hygiene generally. During the attacks *active counter-irritation* is kept up, and *terpine hydrate and salol, creasote and iodine,* or *ammonium salicylate and ammonium iodide,* are given with *codeine* or *Dover's powder. Quinine* is given if there be much fever.

This is an illustration of the general plan to be pursued in tuberculous pleurisy. In cases with moderate effusion, frictions of *iodine in lanolin* may be employed in addition to the use of eliminants, particularly cardiant-diuretics, such as *sparteine* and *digitalis;* or *creasote and iodine* might be injected as into a pulmonary cavity. When the effusion is purulent, free opening and drainage is the preferable procedure. Antiseptic irrigation by means of a double catheter may be done, but it is not always necessary, and is sometimes dangerous. It is often surprising to see how a child with a tuberculous empyema will pick up flesh and strength after removal of the effusion. When pus continues for some time after general recovery to discharge from a fistulous opening, resection of one or more ribs may be performed in order to promote collapse of the chest-wall and obliteration of the pyogenic sac. In Tillmanns's case, already referred to, extensive resection was practised, the pleura curetted, and finally converted by transplantation into a cutaneous cavity.

During and after convalescence from pleurisy, *inspiration of compressed air* is often extremely useful.

Pneumothorax is to be treated by *rest* for the first few days after the accident, *dry or wet cupping, morphine* subcutaneously, and *chloroform* by inhalation. *Paracentesis* may be done with a fine trocar if necessary to relieve the lung from pressure; but this operation had best, if possible, be postponed for a few days to permit the aperture to close. Fraentzel[1] uses an ordinary trocar with a valve of goldbeaters' skin.

Pleurisy should not be actively interfered with, as it is at first protective. The fluid, if not purulent, may be left for a time in the sac, while ordinary sorbefacient remedies are used. If, however, it becomes a source of danger or great discomfort in itself, or if considerable pus collects, it may be removed by means of an *aspirator* or a *trocar.* In case

[1] Cited by Hilton Fagge, *Practice of Medicine,* Philada., 1886, vol. i. p. 959.

of purulent collection a drainage-tube should be inserted, as in any other case of empyema. Bartholow[1] recommends injections of iodine. In a case of Daland's[2] the fistulous opening communicated with a cavity which was antiseptically irrigated through the drainage-tube. A large cavity may give nearly all the physical signs of pyopneumothorax, as in a case of mine at the Philadelphia Hospital. The patient died a few days after admission, and the necropsy showed a large cavity extending from apex to base of the left lung, the anterior wall of which was formed by the pleura, the parietal and visceral pleuræ being agglutinated. In such a case treatment would be useless.

Tuberculous pericarditis does not call for special comment here. I have seen it only in connection with pleurisy.

Lesions of the Pharynx, Fauces, and Contiguous Structures, other than non-specific aphthæ, are not common. They sometimes occur late in the progress of pulmonary tuberculosis, but there is also a distinctive *acute tuberculous pharyngitis*, which belongs to the group of acute disseminated tuberculosis, and may be the initial manifestation. It was long confounded with syphilis. For some years after its description by Isambert it was supposed to be inevitably fatal, but instances of recovery are now accumulating. I saw one case recover in the practice of J. Solis-Cohen. The constitutional treatment is that of the acute infective fever (or chronic condition, as may be). The local treatment is the same in principle as that pursued in cases of accessible ulcerations of other mucous membranes. The ulcerated parts are to be kept clean (*hydrogen-dioxide* spray, wash, or gargle, with or without the addition of *tannin*), and treated with specific and destructive agents (*iodoform, bromoform, ethyl-iodide inhalation, silver-nitrate stick, lactic acid, menthol, electric cautery*); and pain is to be relieved by local analgesics (cocaine, menthol, morphine) or by anodyne medication. These various measures will be detailed more at length in describing the treatment of—

Lesions of the Larynx.—Tuberculous lesions of the larynx may occur independently of demonstrable disease in the lung, but are usually associated with pulmonary lesion, and frequently with additional lesions in other organs. In no case of pulmonary consumption should frequent inspection of the larynx be omitted, so that the earliest sign of disease in that region may be discovered and treated.

Constitutional treatment does not need additional and special discussion. Potassium iodide has been said to have a beneficial effect on laryngeal ulcerations, but I must believe that the cases were syphilitic,

[1] *Practice of Medicine*, N. Y., 1886, p. 375.

[2] *Proceedings Philada. County Med. Society*, vol. viii. p. 114.

either in whole or in part. Syphilis and tuberculosis do coexist, as I have been taught and have seen; and in purely tuberculous cases I have seen potassium iodide, mistakenly administered in the belief that the disease was syphilitic, do rapid harm.

Local treatment varies with the character of the local manifestation. This may be simply a superficial congestion or catarrhal inflammation, presenting nothing specific; or it may be a diffuse or circumscribed infiltration, giving rise to thickenings of tissue, that may greatly embarrass deglutition, interfere with phonation, or even impede respiration; or it may be proliferative in character, as shown by the presence of diffuse vegetations or circumscribed tumors simulating papillomata, most frequently situated in the meso-arytenoid region, but found in any portion of the larynx; or it may be ulcerative. Infiltration usually passes into ulceration, and vegetations may spring from the bed or periphery of ulcers, or may arise without previous ulceration. Ulceration may be superficial or deep-seated, and the former may be simply catarrhal ulceration,[1] not necessarily specific.

Local measures may be divided into five classes: (1) cleansing, (2) astringent, (3) disinfecting or specific, (4) anodyne, and (5) destructive. Those of the last class are not always advisable. Those of the first three classes must, as a rule, be used in conjunction, and are indicated in almost all cases.

Rest is of course the first principle. The full use of the voice must be prohibited, such talking as is absolutely necessary being done in a labial whisper. Cough must be prevented as far as possible by *soothing inhalations*, or, if these be ineffectual, by *opium* or its alkaloids, *hydrocyanic acid*, or *bromine compounds*. Smoking should be prohibited.

The simple laryngitis, congestive or inflammatory, that accompanies chronic pulmonary phthisis calls for no special treatment other than that adopted in chronic laryngitis in general. *Detergent and astringent solutions* may be used in spray. There are many formulæ available for this purpose, one of the best being the following:

Pure carbolic acid,	1 grain;
Sodium borate,	5 grains;
Glycerin,	½ fluidrachm;
Emulsion of coal-tar and soapbark,[2]	¼ fluidrachm;
Water, sufficient to make	1 fluid ounce.

Solution of chlorinated soda may be used in place of the carbolic acid (½ fluidrachm or less to the fluidounce).

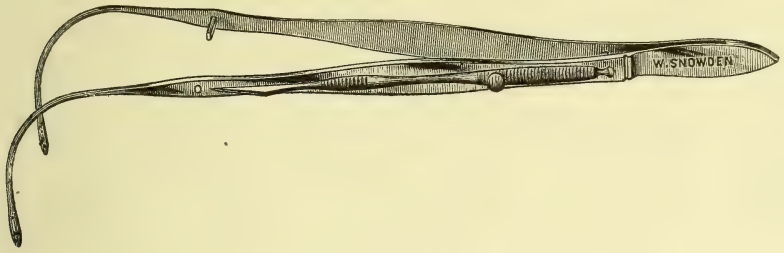
[1] J. Solis-Cohen, *Diseases of the Throat and Nasal Passages*, 2d ed., N. Y., 1879, p. 499; *Trans. Patholog. Soc. Philada.*, vol. vi. p. 83.

[2] *Liquor carbonis detergens*, which, diluted with four parts of water, represents closely the *coal-tar saponine* of Le Boeuf.

Hoffman's *oleoso-balsamic mixture*, which has served as a model for many widely-advertised proprietary preparations, may be used in about the same proportion, taking care that it shall not be too pungent.

For astringent purposes, when there is much diffused congestion, *zinc sulphate* (gr. v *ad* f℥j) may be added, or *silver nitrate* (gr. x–lx *ad* f℥j) may be carefully used in spray, or better by sponge carried in a suitable holder, such as the forceps figured in the illustration (Fig. 169).

FIG. 169.



J. Solis-Cohen's Sponge-Carrier.

Cotton should not be used for endolaryngeal applications, and a brush is likely to prove too irritating. For this reason a piece of clean close-textured sponge should be selected, softened in water, and carefully trimmed to the proper size. When congestion is more localized —as, for instance, to the vocal bands—a *compound solution of iodine and carbolic acid in glycerin* may be used as a topical application by sponge. The same application is usefully made to tumefied parts before ulceration has occurred, the strength being graded according to the condition and to the effect produced.

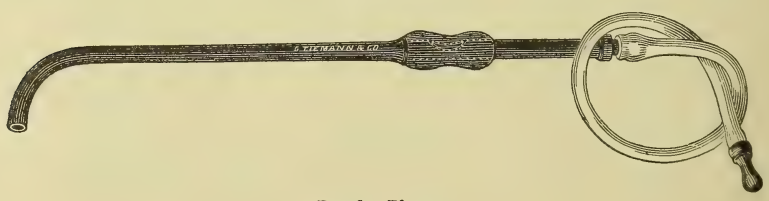
Lactic acid, used as hereafter described, is also recommended (Krause, Heryng) as possessing a specific power to reduce tuberculous infiltrations. Steam inhalations are not, as a rule, desirable, but the *stimulating and antiseptic vapors* used for effect upon the lungs often favorably influence the larynx. Graves put five to ten drops of the *tincture of iodine*, with half a drachm of *tincture of conium* and four ounces of hot water, into an inhaler, from which the patient drew the vapor into his throat for about ten minutes every night and morning. I frequently use *ethyl-iodide*, *terebene*, and *creasote*.

Hoarseness and pain will sometimes be relieved simply by rest. When ulceration is brought about by the lodgment of sputum on the meso-arytenoid fold, or when a vocal band is ulcerated, rest becomes of even greater importance, in order to prevent increase of the lesion and transmission of infection by contact and rubbing. Sometimes, if meso-arytenoid ulceration be detected in the early stages, the process may be held in check by repeated application of cleansing sprays and the topical use of *silver nitrate* (gr. lx *ad* f℥j) to the fissure in the mucous

membrane, that close inspection with the mirror will reveal. Insufflation of *iodoform* will also be useful.

In infiltrative or ulcerative tuberculosis of the larynx, whether acute or chronic, primary or secondary, active local treatment is an absolute necessity. The patient should be seen at least once daily, and whatever line of treatment is decided upon must be persistently and faithfully carried out. Manipulations within the larynx should always be entrusted to one who has acquired the necessary dexterity. They are not easy of performance under any circumstances, and in the tortured and broken-down subjects of tuberculous laryngitis are especially difficult. In many instances—the great majority, indeed—the patient's comfort, and in not a few the ultimate issue in recovery or death, will depend upon the judgment and skill with which endolaryngeal interference is conducted. To depend upon spraying, powder-blowing, or probanging in the dark by patient, nurse, or physician is in most cases simply trifling with the weightiest matters. The inhalations used for pulmonary tuberculosis, especially *chloroform*, *creasote*, and *ethyl iodide*, are *a fortiori* of benefit in the upper air-passages. So too are *carbonic acid* and the *gaseous enemata* of Bergeon. In addition, the larynx should be carefully, gently, and thoroughly sprayed (Bosworth) with an *alkaline detergent solution*, in order to get rid of the accumulated pus and secretions. After this the parts should be sprayed with a solution of *hydrogen dioxide* (equal quantities of a 10-volume solution and of water), and a detergent solution used again after this, in order to get rid of the foamy flakes that form upon the surface from the action of the hydrogen dioxide upon pus and dead tissues. A clean surface will then be presented for the action of additional disinfectants, of which *iodoform* is the best. It may be used alone or mixed with *tannin*,[1] *morphine*, or *bismuth* if indicated, and is best applied by insufflation from a powder-blower, such as is figured in the illustration.

Fig. 170.



Powder-Blower.

Insufflation must be done gently, so as not to excite a paroxysm of coughing, for the powder would then be ejected and the object of the application defeated. When it is impossible to insufflate powdered iodoform, the *solution in ether or chloroform* may be applied by spray,

[1] Morphine sulphate, gr. x; tannin, ʒij; iodoform, ʒij (Bosworth).

but better by means of sponge rapidly introduced and withdrawn. The chloroform-and-collodion solution of iodoform on a sponge or soft cotton wad is one of the best applications to pharyngeal ulcerations. When the larynx is unable to bear this manipulation, it may be previously cocainized by a spray of a 2 to 4 per cent. solution of the anæsthetic or by application with a sponge. Whether the coating with iodoform be done by insufflation or by application of an ethereal solution, it is important to see that all ulcerated surfaces are thoroughly covered. It does no harm to cover the exterior wall of the larynx and the whole endolaryngeal mucous membrane. The important point, however, is to cover the ulcerated surfaces, and one should not be satisfied unless this be accomplished, except in those rare instances when it is impossible either on account of the situation of the ulcers or the unmanageableness of the patient. The greater the skill and experience of the manipulator, the rarer are these exceptional cases. Some stress should be laid upon this point, for I have seen practitioners delude themselves and their patients with the idea that they were making a local application of iodoform to laryngeal ulcers by blowing the powder into the glosso-epiglottic sinus or upon the pharyngeal wall or into the œsophagus.

Menthol was recently brought prominently forward by Rosenberg,[1] and has been especially lauded by Lennox Browne[2] as an efficient endolaryngeal disinfectant and partially anæsthetizing application. Dissolved (5 to 20 per cent.) in olive oil, oil of sweet almond, or one of the bland petroleum products—liquid petrolatum or its proprietary modifications, such as benzoinol (which, of all, I prefer) or albolene—it may be applied by means of an endolaryngeal syringe, or upon sponge, or as a spray. It may also be inhaled from the surface of steaming water, or, better, from the Oliver nebulizer or the "vaseline atomizer." It has given me good results, both as an analgesic and in promoting cicatrization, when the ulceration has not been very deep or extensive. C. H. Knight[3] has had the same experience. Especially soothing is the after-coolness produced by air passing over the surface with which the menthol has been in contact. Some patients, however, have an idiosyncrasy that makes any preparation of mint obnoxious. Gougenheim adds creasote to the mentholated oil.[4] Iodoform may also be combined with it or used similarly.

Resorcin has been recommended, especially by Andeer. I have had but a limited personal experience with this agent, as the results

[1] *Deutsch. med. Woch.*, 1887, p. 338.

[2] *The Throat and Nose, and their Diseases*, Philada., 1890, p. 421.

[3] *Journ. Amer. Med. Ass'n*, Jan. 18, 1890.

[4] *De la Laryngite tuberculeuse, etc.*, Paris, 1890, p. 524: 1. Oil of sweet almond, 100; menthol, 20. 2. Oil of sweet almond, 100; creasote, 10. Mix the two solutions by means of a *bain-marie*. Inject by syringe 2 cubic centimetres (about 30 minims).

obtained were not sufficiently encouraging to induce me to continue its use.

I have recently used *bromoform* on sponge. It causes transient tingling, followed by relief to pain, and seems to promote healing.

These cleansing and disinfecting applications should be made at least once daily, and in some cases more often. Patients can sometimes learn to perform them more or less efficiently, and if circumstances are such as to preclude constant skilled attendance the attempt should be made to have the treatment carried out in this way. A commercial traveller who came under my observation in 1883 at the Philadelphia Polyclinic, learned to insufflate iodoform into his larynx by the use of a flexible rubber catheter and a hand-ball. He did this thrice daily while on his travels, recovered, and is still living and well. There was no question of diagnosis, as lungs and larynx were both characteristically involved. The diagnosis was concurred in by J. Solis-Cohen.

Destructive Measures are indicated in primary ulcerative or proliferative tuberculosis of the larynx, not of the acute disseminated variety; and in secondary tuberculosis when the lesions (ulcerations or vegetations) are accessible, if the disease in the lungs is not hopelessly advanced, and the patient's strength is sufficient to bear the manipulation. Unless destruction can be thorough it is useless, except to secure breathing-space when the lumen of the air-tube has been encroached upon; but when thorough it often saves life. Thus, J. Solis-Cohen in 1870 excised the ulcerated epiglottis of a patient with phthisis, who recovered and twelve years later was reported as in good health.[1] It is rare, however, that the lesions are so limited or so favorably situated that *the knife* can be used to advantage.

Of other destructive agents, *electrolysis*, the *electric cautery*, *chromic acid*, *carbolic acid*, *acid mercury nitrate*, *zinc chloride*, and *silver nitrate* have been recommended. Better than any of these, however, and attended with less risk of the production of œdema of the larynx than the more active of them, is *lactic acid*. This agent was introduced in 1885 by H. Krause,[2] who derived the idea of resorting to it from the success with which v. Mosetig-Moorhof had used it against epitheliomata. It seemed to destroy morbid cells, while powerless against normal tissue. It is best applied in the following manner: The larynx (or pharynx) being thoroughly cleansed and cocainized, a sponge carrying a 10 or 15 per cent. solution of lactic acid is introduced, and the ulcerated or infiltrated parts thoroughly rubbed. The friction must be made with some force to be effective. Hence the necessity for thorough anæsthesia. The strength of the lactic-acid

[1] Personal communication.

[2] "Milchsaure gegen Larynxtuberculose," *Berliner klin. Woch.*, 1885, No. 29.

solution is increased at consecutive sittings, until finally it reaches about 50 per cent. In some cases the concentrated solution (80 per cent.) is employed. Lactic acid destroys tubercle and tuberculized tissue, but does not attack healthy structure. Very encouraging results have been reported from this method by Heryng,[1] Gougenheim, Schmidt,[2] Browne, and others, and I have repeatedly seen healing of ulcerations follow its use in my own practice. After the lactic-acid frictions I am in the habit of insufflating iodoform. Previous to the application of lactic acid Heryng[3] has recommended a thorough curettage of the bed of ulcers, the object being to get rid as far as possible of every vestige of diseased tissue. He also makes deep multiple incisions into non-ulcerated infiltrations, and commences next day with lactic-acid frictions. This more energetic treatment requires the application of cocaine (15 to 20 per cent.) after the applications as well as before them, and the pain may be still further diminished by gargles of ice-water and by cold compresses over the larynx externally. In severe cases Heryng injects under the mucous membrane from 4 to 8 drops of a solution of cocaine (10 per cent.) in a 2 per cent. solution of carbolic acid. This produces anæsthesia in from five to seven minutes. Major of Montreal injects lactic acid deeply into the infiltrated tissues, 5 to 10 drops of a 20 per cent. solution being employed at first, and the strength increased according to the effect. The injections are repeated at intervals of two or three days. This method has given good results in the practice of J. Solis-Cohen. The last-mentioned surgeon uses Morell Mackenzie's gouge-forceps to remove tuberculous vegetations, and rubs the seat of attachment with lactic acid. I have used *chromic acid* for the same purpose, the crystals fused on the end of a silver or aluminium probe properly guarded. MacCoy's "laryngeal applicator" is an admirable instrument for this purpose. *Electric cauterization* served me well in one case for a while, but the last manipulation set up an œdema laryngis that was both troublesome and dangerous, and almost necessitated tracheotomy. But we cannot here fully discuss details of manipulations which should not be attempted except by a skilled hand.

Whenever from swelling of the tissues; from nervous impairment causing partial paralysis of the vocal bands; from the presence of vegetations; from the threatening of perichondritis and abscess; or from other cause; there is fear entertained as to the preservation of the integrity of the calibre of the air-tube, and of consequent suffocation, a *prophylactic tracheotomy* should be performed. Kerkowski,[4] Beverly

[1] "Ueber die Heilbarkeit und Therapie der Larynxphthisie," separat abdruck aus der *Deutscher med. Woch.*, Leipzig, 1887.

[2] *Ibid.*

[3] *Die Heilbarkeit der Larynxphthisie und ihre Chirurgische Behandlung*, Stuttgart, 1887, p. 73, *et seq.*

[4] *Przegladckarski*, No. 13, 1877; *Allegem. Med. Cent. Zeit.* No. 65, 1877, cited by Cohen.

Robinson,[1] Moritz Schmidt,[2] and others, have indeed advocated tracheotomy as a routine measure in certain cases of tuberculous laryngitis, with the idea of securing rest to the larynx; but the suggestion has not met with general favor, despite the fact that the practice has been again pressed within recent years by v. Bruns, Hunter Mackenzie, and M. Schmidt. After the prophylactic tracheotomy here advised, destruction of growths by evulsion, cautery, or otherwise, or appropriate treatment of other lesion, is of course to be carried out. Patients have lived from a few weeks or few months to so many as seven years (Kerkowski) after tracheotomy. In one case under my care healing of the external wound was prevented by tuberculous infection of its edges. This is the only experience of the kind I have met with, but it indicates a possible drawback to a *laryngotomy* that might otherwise be indicated, in favorable early cases, for the better access to, and more thorough eradication of, tuberculized parts. With the views I hold concerning tuberculosis, I could not approve of *excision of the larynx*, which has been suggested, but, so far as I know, done only through mistake for carcinoma. The patient survived the operation, but died some months later in the natural progress of the disease. "Laryngectomy would be justified only in extensive primary tuberculosis of the larynx in an otherwise healthy subject, involving nearly or quite an entire half of the organ, or such an extensive continuous portion as could not be thoroughly freed by an endolaryngeal operation, or even by splitting the larynx."[3]

One of the most distressing features of a case of tuberculous ulceration of the pharynx or in a case of tuberculosis of the larynx when the epiglottis is attacked, is the great difficulty in swallowing, sometimes amounting to a positive disability to take food, on account of the excessive pain caused by the passage of the bolus over the ulcerated surfaces. Water sometimes gives more pain than food does, and, on account of its greater fluidity, passes more readily into the larynx, exciting distressing paroxysms of cough. In such cases the ingenuity of the physician and his fertility in resource will be taxed to the utmost. Solid food cannot be taken, milk and soups are sometimes too thin, and thus dependence must in some cases be had upon bland, mucilaginous, and semisolid foods—corn starch, gelatin, and jellies, thickened peptonized milk-gruel, arrowroot, and barley-water, custard, raw eggs, the beef-pastes, etc. The avoidance of pepper, spices, acids, or extremes of heat or cold is quite important in preparing nutriment. In some cases ice-cream and water-ices can be taken without discomfort, but, as a rule, cold is unpleasant. Gulping the food gives less pain than sipping does.

[1] *Amer. Journ. Med. Sci.*, April, 1879.
[2] *Deutsch. Archiv für klin. Med.*, vol. xxvi., 1880, p. 364.
[3] J. Solis-Cohen, personal communication.

The introduction of *cocaine* has proved a great boon to those suffering from this form of disease, but it by no means enables us to entirely overcome the difficulty. Just before the act of deglutition is to be performed a solution of cocaine (5 to 10 per cent.) may be applied either by spray or sponge. Sometimes the patient may be able a few minutes before taking food to slowly swallow a tea-spoonful of glycerin containing from $\frac{1}{8}$ grain to $\frac{1}{2}$ grain of cocaine. The spoon containing the anæsthetic mixture should be carried back toward the base of the tongue, and there inverted, so that the solution may trickle slowly down and coat the sore places; or the mixture may be swallowed from a brush introduced in the same way. *Lozenges of cocaine* alone, or with *morphine* or *codeine*, in gelatin or fruit-jelly, may be tried, as also powders of *bismuth* or *bismuth and morphine*, or the same with *cocaine*. In a case of carcinomatous ulceration the latter combination was very useful, permitting food to be taken without pain; and it might also prove of service in tuberculosis. Norris Wolfenden[1] has suggested an ingenious method of giving food or the water so thirsted for in cases of epiglottic ulceration. The patient lies prone on a couch, his heels higher than his head, and sucks the fluid by means of a rubber tube from a vessel held below the level of his mouth. In some cases *artificial feeding* by the rectum or by means of a soft-rubber œsophageal catheter will have to be resorted to. Indeed, it is often wise to begin the use of nourishing enemata, as a supplement to the ordinary method of alimentation, before they become absolutely necessary. In this way we delay or prevent that great exhaustion which renders attempts at artificial nourishment futile. In artificial feeding by the œsophagus a tube of as small calibre as possible should be used. While it is not necessary to introduce the œsophageal catheter into the stomach, the tube should be sufficiently long to pass for at least two inches beyond the entrance of the larynx; otherwise a sudden motion of the patient may dislodge it and cause the food to be propelled into the larynx instead of the œsophagus. I believe that the death of a rich man who, in order to save physician's fees, insisted upon having his son perform this operation for him, was accelerated by some such accident. Cocaine should be applied before the tube is inserted, and the tube itself coated with glycerin containing cocaine. A very good solution for feeding in this way consists of one quart of warm (100° F.) milk, containing two table-spoonfuls of beef powder, an ounce of brandy, and three raw eggs, with or without the addition of scale pepsin (fifteen grains) and diluted hydrochloric acid (thirty minims). If peptonized milk and beef be used the pepsin may be omitted.

For the relief of pain, which is often very severe, *cocaine* solutions may be employed in spray or by sponge, *alkalinized solutions of mor-*

[1] *Lancet*, July 2, 1887.

phine (gr. v–x *ad* f℥j) may be used by spray, *morphine oleate* (2 per cent.) or *aconitine oleate* (2 per cent.) applied with sponge, or *powders containing morphine* (gr. $\frac{1}{8}$ to $\frac{1}{4}$) be insufflated. *Starch, tannin, bismuth subnitrate, bismuth salicylate,* or *bismuth subiodide* may be employed as the vehicle. Cocaine may also be applied in powder or added to the iodoform employed as before described.

Very often local measures utterly fail to relieve pain, and recourse must be had to *hypodermatic injections of morphine.*

Tuberculous Ulceration of the Tongue is not at all a common manifestation, but it is perhaps not so infrequent as was formerly supposed. It may be primary or secondary. I have never seen, or at least recognized, a primary case. It may be mistaken for syphilis or for epithelioma.

In addition to such palliation as pain may necessitate, if the lesion be superficial and limited it may be treated by cleansing with *hydrogen dioxide, curetting, lactic-acid friction,* and applications of *iodine, carbolic acid and glycerin, iodoform,* and the like, or the *electric cautery* may be used for thorough destruction of diseased tissue. The cautery blade should be brought to a glowing red heat, applied to only a small portion of tissue at a time, and not too deeply. If these and similar measures do not stay the progress of the disease, or if there be extensive lesions at first, and there is not much pulmonary or pharyngeal involvement, *excision* or *extirpation* should be practised. If necessary, in order to thoroughly eradicate the disease an entire half or even the whole of the organ should be removed. The propriety of surgical procedure of some sort is now so well established that it will be unnecessary for our purpose to cite cases or authorities other than to refer to the case of Delavan[1] and Bull of exsection of the whole tongue for limited primary ulceration, which resulted in perfect recovery without secondary involvement. Even should death occur later from pulmonary tuberculosis, the patient will have been spared much suffering and his life greatly prolonged. I am therefore in favor of partial or complete excision as a palliative measure in selected cases. When the disease is too extensive locally or generally to warrant extirpation, milder *palliative measures* only can be employed—*cleansing, iodoform, bromoform, cocaine,* and *morphine* locally, *morphine* by the mouth or hypodermatically, *feeding by rectum* and through *nasal tube.*

Tuberculosis of the Nasal Passages,[2] other than lupus, is rare, or at least infrequently recognized. Scrofulous disease of the nasal bones has not been proved to be tuberculous. This is not uncommon.

The principles of treatment that apply here are not different from

[1] *New York Med. Journ.,* May 14, 1887.

[2] Cartaz has published an interesting study, *De la Tuberculose nasale,* Paris, 1887, with references to literature up to date of publication.

those which guide us in other regions. Diseased tissues are to be removed as thoroughly as possible; careful exploration, by probe or finger, or both, must be made for necrosed bone, and if such be found, forceps, scoop, curette, trephine, or other available instrument be employed for thorough removal. *Hydrogen dioxide* as a cleansing agent, *lactic acid*, the *electric cautery*, *iodoform*, and *bromoform* as destructive and anti-tuberculous applications, are the best means at our command to meet the respective indications. *Ethyl iodide*, *creasote*, and *eucalyptol* by inhalation are esteemed useful for continuous effect. *Menthol* by spray has also given me much satisfaction in the management of scrofulous ozæna.

In 1883, I removed several fragments of nasal bones from a puny lad of twelve years of age, and, being moved thereto by his chorea, treated him constitutionally with arsenic iodide. I have seen and examined both his parents, and there is no suspicion of syphilis or of direct tuberculous inheritance. He improved rapidly, and I lost sight of him. He returned recently, tall, thin, long-necked, with long and narrow thorax, to be treated for "a cold." I placed him upon treatment applicable to bronchitis in a tuberculous subject, and he recovered and gave no sign of phthisis. He told me—and this is why I have narrated the case—that in the mean time he had lost a sister by "quick consumption." Was his nasal disease tuberculosis? No bacteriological investigation was made at the time.

Lesions of the Peritoneum.—Tuberculous disease of the peritoneum is confessedly obscure of diagnosis, and clinical classification is thus rendered extremely difficult. For our purpose it will be sufficient to recognize that it may occur as part of a general tuberculosis, may be secondary to local tuberculosis elsewhere, or in rare instances be apparently primary. It may be acute or chronic, and in either case circumscribed or diffuse, with frank symptoms or such latency as to be unrecognized during life. It is quite common in childhood, when it is frequently secondary to intestinal and glandular disease. So called "tabes mesenterica"[1] is often peritoneal tuberculosis. Osler[2] gives the greatest frequency as between the ages of twenty and forty, which, however, does not accord with the impressions derived from clinical experience. The discrepancy is doubtless due to the fact that the greatest mass of cases is not recorded and does not come under the pathologist's observation. The disease may, however, occur at any age. In Osler's tables there are two cases over seventy years, and I saw, in the body of a senile dement probably past seventy years, who died of meningitis in my ward at the Philadelphia Hospital, a recent miliary tuberculosis of the peritoneum which had given no sign during life. There were old healed lesions in the lungs. The specimen was exhibited to the Philadelphia Pathological Society. Of late years,

[1] *Vide* Gairdner, *op. cit.* [2] *Johns Hopkins Hosp. Reports*, vol. ii. No. 2, Balt., 1890.

since abdominal section has become so common, peritoneal tuberculosis has frequently been discovered in women operated upon for supposed ovarian cysts or other lesions, and the famous case of Sir Spencer Wells[1] is an earlier example of the same experience. Its tendencies to latency and to spontaneous healing have thus been pretty firmly established, permitting not only a revision of the earlier opinion that all cases of recovery were cases of mistaken diagnosis, but also, as Gairdner[2] suggests, raising the question as to whether, in view of that revision of opinion, the operations recently undertaken so successfully are really to be credited with the recoveries that have followed.

Operation for tuberculous peritonitis consists in opening the abdomen; removing any effusion; removing any localized focus of disease in a removable organ, such as the ovary; or if none such exist either irrigating with hot water, solution of carbolic acid (1 per cent.), or iodine (1 to 500), or making other antiseptic or supposed specific application, such as dusting with iodoform; and closing the wound, with or without drainage.

Czerny,[3] reporting a number of cases with good and bad results, warns against taking too hopeful a view of the results of operative interference in tuberculosis of the peritoneum and intraperitoneal organs. If we look only at the statistics of operations as gathered by Kummell,[4] Trzebicky,[5] and others, he says, we shall deem "that tuberculous peritonitis belongs to those forms of tuberculosis which may most readily be cured by mechanical therapy." He shrewdly suspects that "the literary dictum has become too favorable" through haste to publish cases before the ultimate issue has been determined. "If not alone all cases operated upon, but also the fate of the patients after dismissal, were made known, the statistics of operation would be less happy." This criticism, however, will not apply to all published reports. Czerny himself reports the cases of patients well after ten years, thirty-eight months, eight months, and six months respectively; and is indeed encouraged to give expression to the positive opinion that tuberculosis of the genitalia, the intestine, or the mesenteric lymph-glands demands operation before it has given rise to diffuse peritonitis. Knagg's[6] two cases of tuberculous peritonitis—one a woman of forty-three years, the other a girl of sixteen years—were well three and two years respectively after operation. Clarke's,[7] a girl of thirteen, was well two years after operation. Sir Spencer Wells's patient, operated upon in 1862, married and had children, and was

[1] Cited by McCall Anderson, *Clinical Lectures*, 1877.

[2] "Tabes Mesenterica," *Lectures to Practitioners*, London, 1888, p. 71.

[3] *Ueber die Chirurgische Behandlung intraperitonealer Tuberkulose*, Heidelberg, 1889.

[4] *Verhandlung. der deutsch. Gellsch. f. Chir.*, 1887, ii. 323.

[5] *Wiener med. Woch.*, No. 6 u. 7, 1888.

[6] *Clin. Soc. Trans.*, Lond., vol. xxii., Supplementary Reports.

[7] *Ibid.*

well at last reports; and many other cases might be cited. On the other hand, Bruen's[1] patient, a man of thirty-four, with chronic tuberculosis of the peritoneum, "whose general condition was excellent," died from acute septic peritonitis nine days after operation. Four of Czerny's cases died within two, three, or four months with secondary manifestations. In one case death occurred in five weeks from acute miliary tuberculosis, and in three cases within a few days or weeks from septic peritonitis or from the original disease. Czerny remarks upon the infrequency of operations upon men, and suggests it is because they are treated by "internal clinicians;" while women seek the gynæcologist and surgeon.

It is to be remembered that included in these cases of Czerny's (to which I call particular attention, because they are the experience of one operator, a bold and skilful surgeon, and are typically illustrative of the various forms of abdominal tuberculosis as well as of the difficulty of diagnosis) are many cases in which operation was undertaken under the impression that some other condition was present; but the same remark will apply to the overwhelming number of operations.

Spaeth,[2] reporting four fatal cases, and analyzing, perhaps a little hypercritically, the statistics of recorded operations, comes to the conclusion that in primary peritoneal tuberculosis without involvement of other organs, (which, he says, is a rare disease and difficult of diagnosis), section is curative; that in cases complicated with tuberculosis of the female sexual apparatus definite results cannot be anticipated whether extirpation be practised or not; that in cases secondary to intestinal ulceration section is only palliative; that in tuberculosis of the genitalia without peritoneal involvement operation is indicated, but exact diagnosis is almost impossible, owing to the difficulty of obtaining bacteriological evidence.

On the other hand, Koenig[3] states that of 131 cases of peritoneal tuberculosis treated by abdominal section, 65 per cent. were cured and 18 per cent. greatly improved, while in only 3 per cent. could death be attributed to the operation. The only procedure common to all cases, and hence the procedure to which alone the results must be attributed, was opening of the abdomen and more or less manipulation of its contents. The greater number of cures is recorded in cases in which disinfectants were not used. The form of the disease, according to Koenig, is immaterial. All forms have undergone resolution after section, and hence all forms are curable.

It seems to me, after a careful study of the attainable literature, that, assuming the diagnosis to have been made, the question of ope-

[1] *Proceedings Philada. County Med. Society*, vol. viii. p. 201.

[2] *Deutsch. med. Woch.*, 1889, p. 395.

[3] *Centralbl. f. Chir.*, No. 35, 1890.

ration is to be decided neither upon statistics nor upon the name given to the disease, but upon the general indications of the individual case. In other words, the fact of the disease being tuberculous should not of itself make for or against operation; while the presence and extent of lesions elsewhere, or the absence of such lesions, the recuperative powers of the patient, the agglutinative or non-agglutinative, suppurative or non-suppurative, diffuse or circumscribed, character of the process—taken in conjunction, but not separately—should guide the decision. For the present I should say, If in doubt operate. Furthermore, the moment operation enters his thought, the physician should obtain the counsel of the surgeon, that the two may watch the case together and decide intelligently and in time to be of use.

In the treatment of *acute tuberculosis of the peritoneum*, when this is a part of *general tuberculosis*, the local manifestations call for palliative measures only. Pain will sometimes be relieved by *hot poultices*, by *turpentine stupes*, or by the *ice-bag;* if these be ineffectual *opium* must be given. Tympanites is treated with *turpentine stupes*, *mild sinapisms*, or *hot applications*. *Turpentine* or *charcoal* may be given internally. Most frequently, however, these symptoms are dependent on intestinal conditions, and treatment must be shaped accordingly. Disinfectants and sedatives, such as *bismuth*, *salol*, *naphthalin*, *creasote*, may be employed. A mixture of *carbolic acid* (gtt. j) and *tincture of iodine* (gtt. ij), as recommended by Bartholow for use in typhoid fever, will sometimes be of service. In one case the "*gouttes amères*" of the French Pharmacopœia (gtt. iij–x), in another case *sodium sulphocarbolate* (gr. v), followed by *chloroform-water* (f℥ss), helped to control this very distressing symptom. *Camphor-water* sometimes mitigates the distress without dissipating the cause. Very often all measures will fail.

When not part of a general acute infection, *acute tuberculous peritonitis* still calls for treatment upon general principles. It may be secondary to recognized disease elsewhere, or occur apparently as a primary manifestation. *Rest;* the application of *cold water* to reduce fever, and especially cold applications to the abdomen; the use of *alcohol* and *predigested foods;* the administration of *cod-liver oil*, *creasote*, and *calomel;* with *sparteine* as a diuretic, *opium* as an anodyne, and *strychnine* as a tonic; *inunctions of cod-liver oil; iodized* and *mercurial inunctions* for influence upon collateral inflammation; or such other medication as the symptoms may indicate, comprise the purely medicinal measures; which are to be chosen and applied in accordance with individual indications. *Codeine* sometimes seems of special service in reducing the violence of inflammation or checking its spread. McCall Anderson[1] in his cases of recovery gave no other medicines than morphine and quinine. Sometimes to relieve pain and distension

[1] *Op. cit.*, p. 104.

hot applications will have to be made to the abdomen, despite fever. Effusion may be absent; if slight, no special treatment is required; if considerable, it may be drawn off; or if suppurative, the abdomen may be opened, irrigated, and drained. According to Osler,[1] these cases offer the best prospect of recovery by means of surgical interference; as "the disease is more likely to be primary in the peritoneum, the general condition is usually better and the subsequent chances of general infection are much slighter." The manner in which operation acts is at present inexplicable. It certainly does, apart from the removal of whatever be removed,[2] wonderfully influence nutritive metabolism; and Tait has pointed out the remarkable tendency of neoplasms of the peritoneal cavity to undergo retrograde metamorphosis after a mere exploratory incision.

Chronic Tuberculosis of the Peritoneum—a disease more common among children and adolescents than is generally recognized—calls first for our general tonic and invigorating measures; with special reference to selection of food, whether for infants or adults. *Cod-liver oil* is extremely useful as a food, especially with children. *Creasote* may be given with it. *Arsenic, iodoform, iron iodide,* and *strychnine* are likewise appropriate for internal medication. Mild *counter-irritation,* as by friction with *iodine* or *mercurial liniments,* is often useful. Pain is to be relieved with *opium,* freely given while the occasion lasts. Cases with purulent exudations should be treated by *incision, irrigation, and drainage,* if only as a palliative measure. In diffuse non-purulent effusions the attempt may first be made to remove the fluid by *tapping* if interference be necessary and other measures have proved ineffective. Intraperitoneal injections of creasote and iodine might perhaps be useful. I say this with some reserve, as I have not tried the measure. If tapping is not effectual, then *incision,* made aseptically and with due caution against spreading the infection, can at least do no harm and may do good. "In the chronic adhesive form," as Osler points out—and this seems also to be the opinion of Czerny—"no benefit could be expected to follow the operation, which could only be intended to remove an omental mass or to open a sacculated effusion. In the majority of the cases of this group Nature is effecting a cure in which she scarcely needs outside assistance, and the danger lies not so much in the peritoneal disease as in the risk of pulmonary infection."

In connection with this subject the comparative frequency of tuberculosis[3] of the intra-abdominal generative organs of the female must be specifically mentioned. The proper treatment seems to be surgical,

[1] *Loc. cit.*

[2] Cameron (cited by Knagg, *Clin. Soc. Trans.*, London, 1887, vol. xxi. p. 37, *seq.*) suggests that ptomaïnes are drained off.

[3] Hegar, *Genitaltuberculose des Weibes,* Stuttgart, 1886.

and indeed the diagnosis is often made only at the time of operation. General infection may be prevented by prompt removal of a tube affected with primary tuberculosis.

Tuberculosis of the Kidney, if leading to suppuration, should be treated surgically. Free incision and drainage are always good practice. The question of extirpation of the organ must be decided, exactly as in other cases of purulent kidney, upon individual indication, and not statistics. My own opinion is strongly in favor of the operation, unless the extent of the disease or the weakness of the patient should counter-indicate it.

Tuberculosis of the Bladder or Urethra is to be treated by soothing antiseptic and specific irrigations and topical applications.

Lesions of the Testicle.—Surgeons are practically agreed as to the wisdom of extirpating a tuberculous testicle. The only reasons for non-interference would be the coincidence of hopelessly advanced disease in the lungs or elsewhere, or such extensive involvement of the testicular appendages as to render thorough removal impracticable or dangerous. Bardenheuer,[1] believing the process, as a rule, to begin in the epididymis, advocates early resection. It is easier to obtain the patient's consent, and the procedure, if timely, is effectual.

Tuberculosis of the Vulva and Vagina is to be treated upon the same principles as apply in other accessible regions.

Fistula in Ano.—Many authorities deprecate interference with anal fistula, some because they deem it unwise to check an issue, and others because they consider any operation in a consumptive patient liable to do harm, while even local healing cannot be achieved. I do not share these views. Every source of discomfort and drain on the strength should be avoided or remedied when possible. I advocate, therefore, effective surgical procedure[2] in every case of anal fistule in a consumptive, unless the patient's strength be so far gone as to give apprehension of evil result. The endeavor should be made to excise, or remove by lactic acid or caustic alkali, all involved tissue, and I think the wound is best treated with iodoform.

Lesions of the Brain and Meninges.—Unfortunately, little can be said of these therapeutically. The tuberculous tumor does not as yet promise well for surgery, and is practically beyond the reach of medication. Palliation of symptoms and treatment on general principles are to be instituted in the hope that arrest of the disease is not impossible. Jacobi[3] believes tuberculous meningitis to be fatal in nearly all cases, and is dubious as to the correctness of the diagnosis in

[1] *Die Operative Behandlung der Hodentuberculose durch Resection der Nebenhoden*, Köln und Leipzig, 1886.

[2] *Vide* Allingham, *British Med. Journ.*, April 12, 1890.

[3] *Loc. cit.*

those that recover. Hilton Fagge[1] wisely says that we should be "very cautious in asserting that it is impossible for a patient to get over an attack of what appears to be tuberculous meningitis," and advocates persistent hopeful treatment to the last. The insidious development of the disease in children may give us some opportunity to attempt to retard its progress if we recognize the danger in time. *Rest* and *quiet*, even the "cool, dark, well-ventilated room"—which are absolutely necessary when inflammatory symptoms become acutely manifested—may be instituted earlier in the hope of warding off the violent outbreak. *Free purgation* with *calomel* and *salines*, *mercurial and iodine frictions* over the shaved scalp and along the cervical spine, and in the frank stage *cold applications* to the head and spine, are indicated; with *anodynes*, *opiates*, and *hypnotics* to relieve restlessness and pain; and *stimulants*, such as *musk*, *ammonia*, *ozonic ether*, and *camphor*, hypodermatically if necessary, in the attempt to sustain life toward the close. Food is to be given, general or specific medication administered, or other measures adopted, on general principles according to special indications and complications, as discussed in the treatment of acute disseminated tuberculosis. If death (as is too probable) results notwithstanding, we have the consolation that we have not stood idly by; for if mistaken diagnosis is possible in cases that recover, is not mistaken diagnosis likewise possible in cases that perish, but might have been saved?

Special Symptoms.

A few special symptoms, principally in connection with pulmonary phthisis, are sufficiently important to demand brief additional comment.

Fever.—We have spoken of the fever of acute disseminated tuberculosis and that of acute phthisis, and in connection with toxæmia have treated of the fevers of tubercle-formation, inflammation, and septic absorption. We relied principally on *rest*, *cold applications*, and *antiseptic* and *soothing medication*. The same measures apply to other acute processes and the acute exacerbations in chronic processes. In hopelessly advanced cases, however, when recovery is impossible, and high fever, not controlled by the general medication or sedative inhalations, torments the closing days, I would not object to the use of antipyretic drugs, of which I prefer *salicin* or *quinine* (as indicated), *phenacetin* (gr. iv), or *acetanilide* (gr. iv), once, twice, or oftener in the twenty-four hours as may be necessary. It is best to study the time of maximum effect in each case, and adjust the administration of the drug to the course of the fever. While antipyretic medication is at times more feasible than cold applications under these circumstances,

[1] *Op. cit.*

sponging with tepid aromatized water is often very soothing, and a cooling spray of cologne-water will afford relief when drugs absolutely fail.

Hæmoptysis.—Nothing is so alarming to the patient and his friends as a hæmorrhage. The first thing to be done is to calm their fears. It is only in rare cases that hæmorrhages are fatal, whether by loss of blood, or by the inflammation excited by extensive clots, or by suffocation by filling the alveoli. Patients may, however, narrowly escape drowning, if the hæmorrhage be at all profuse, unless they are turned or are able to turn themselves, so as to let the blood run out freely while the bleeding continues. Efforts to hold the blood back are injudicious. If free bleeding is so managed as to avoid suffocation, it may prove beneficial by relieving congestion. I know of two cases in which pulmonary hæmorrhages occurred at more or less frequent intervals during prolonged periods—in one case forty years, in the other nearly twenty years—the patients suffering comparatively little in the mean time. This recalls the old practice of bleeding for consumption, which, while doubtless much abused, probably had some foundation. I am unable to suggest indications.

Slight hæmoptysis may be allowed to go at times without interference. The measures to be adopted will differ in nature and activity according as the hæmorrhage occurs before or after cavity-formation, and is attended or unattended with pyrexia. It is necessary to bear in mind the danger of inflammation following even comparatively mild hæmorrhage if there be much retention of blood in the alveoli, and to take precautionary measures, such as counter-irritation and the use of opium and quinine, on the first manifestation of symptoms premonitory of such a result. Describing here the treatment of rather profuse hæmorrhage in the late stage, the modifications for less severe cases will be readily suggested.

Rest is the first indication. The patient should be gotten to bed, or on his back on a lounge or easy-chair, as soon as possible, the head and shoulders but slightly elevated, so as to prevent the blood which rises into the throat from immediately regurgitating. Feather beds and feather pillows are objectionable. He should be instructed to turn his head to the side during the paroxysms of bleeding, and depress the chin slightly in order to favor the exit of blood. The use of the voice must be interdicted. The chest and extremities should be kept as still as possible, and cough and restlessness be controlled by *opium;* morphine being given hypodermatically if necessary. Little pieces of *ice* should be kept in the mouth. An *ice-bag* should be placed over the heart, and tincture of *aconite* (℥ij–v, *p. r. n.*) given to quiet the circulation. Inhalations of *amyl nitrite* may be used to dilate the systemic and pulmonic capillaries, and thus help to diminish the pres-

sure upon the ruptured vessel or vessels. With similar intent of diverting the circulatory current and reducing pressure, *dry cupping* of the lower extremities and the base of the chest is practised. Jaccoud advises the application of from forty to sixty cupping-glasses twice daily, or in extreme cases the application of Junoud's boot. Digitalis is sometimes given to check hæmorrhage, but I have no experience with this measure. Strapping the upper or lower extremities to prevent return of blood to the venæ cavæ has been resorted to. Military surgeons sometimes perform venesection in cases of wound of the lung, and if bleeding from one arm is not sufficient they bleed from the other arm. The object is not only to reduce blood-pressure, but also to induce syncope. The same principle might apply in rupture of an aneurism within a pulmonary cavity when the patient is plethoric and when bleeding is uncontrollable by other means. In addition to rest, opium, cold, cardiac depressants and vascular relaxants—*astringents* and *hæmostatics* of known and unknown method of action, may be employed. These are, however, more useful in milder than in severe cases, while most urgently indicated in the latter.

Table salt is a domestic remedy of great repute. I sometimes leave directions to use it should an emergency arise.

Ergot in doses of from 10 to 60 minims of the fluid extract may be given every half hour at first, the intervals being gradually lengthened and the dose reduced as the bleeding diminishes. In more urgent circumstances ergotine may be injected hypodermatically.

Fluid extract of matico (f℥j, *p. r. n.*) may be used in conjunction with ergot or in place of the latter. DaCosta recommends this drug highly. I have sometimes given ergot and matico alternately.

Oil of turpentine in capsule, or, better, in emulsion or on sugar, may be given in doses of from 5 to 20 minims every half hour, hour, or second hour, gradually increasing the intervals. Turpentine by inhalation in a steam spray or Oliver nebulizer may be used, the patient being cautioned against making any unusual inspiratory effort.

Oil of erigeron may be combined with turpentine or used in its place in the same doses. *Eucalyptol* is less powerful as a hæmostatic than either of these, but may be given if it is at hand and the others are not. Germain Sée uses terpine.[1] Williams administers *tannic acid* (gr. ij), *gallic acid* (gr. x), or *lead acetate* (gr. v) every few hours. When lead is given he follows it with morning draughts of magnesium sulphate and sulphuric acid. *Aromatic sulphuric acid*, freely given, is sometimes a useful hæmostatic. *Extract of hamamelis* has been given, and the use of *tar-water* has recently been revived by St. Marc,[2] 10 to 15 drachms being given during the twenty-four hours.

[1] Cited in *Medical News*, Aug. 3, 1885. [2] Cited in *Lancet*, May 12, 1888.

Trousseau highly recommended powder of *ipecacuanha* in nauseating doses (10 to 15 grains every ten minutes for three doses). Jaccoud gives the same drug in much smaller doses in profuse or persistent hæmorrhage in the early stages or less profuse bleeding attended with fever. His practice is to give 1½ grains (10 centigrm.) every fifteen minutes until nausea is produced without vomiting. Then the intervals are lengthened to every half hour, hour, or two hours, according to the state of the pulse, the temperature, and the inclination to vomit. The treatment is not devoid of danger, and hence the effect must be carefully watched. When a decided impression is produced the drug is discontinued for the time being. During this depressing treatment the strength is sustained by iced wine and cold soup. *Antipyrin* has considerable reputation as a hæmostatic. I have not used it. If there be much fever, *quinine sulphate*, or, better, *quinine hydrobromate*, may be given with ergot. *Iodoform* is recommended by Chauvin and Jorisenne,[1] who give from ¾ grain to 1½ grains, with *tannin* and *extract of gentian*, in pill, three times a day.

Hausmann[2] employs hypodermatic injections of *atropine* ($\frac{1}{200}$ grain) in cases of recurring hæmorrhage—a practice recommended by Tacke[3] in 1882.

Inhalations, by spray, of *Monsel's salt*, *perchloride of iron*, *alum*, *gallic acid*, and the like have been given; but I have not seen the necessity for such procedure in mild cases, or observed any good result from it in severe ones. Still, it is an additional resource to be borne in mind.

The bowels should be kept freely open by the use of mercurials or mild salines. Food should be restricted in amount, and be cold and of the blandest character—cold milk, cold custard, ice cream, and the like. According to necessity and indication it may be given in portions of from a teaspoonful or two every half hour to two ounces, more or less, every two hours. Alcohol, unless in the form of very thin wine or iced champagne, must be prohibited.

Percussion is out of place nor should the trunk be lifted for auscultation.

Cayley[4] treated a case of severe hæmoptysis by the induction of pneumothorax, so as to bring about collapse of the lung. An incision was made in the sixth intercostal space an inch behind the anterior fold of the axilla. Into the pleural cavity was introduced a double tube made by uniting by means of a shield two pieces of elastic catheter about three inches long. The opening was protected by a small cage lined with carbolic gauze, and the whole covered by a carbolized-gauze

[1] *Cong. de la T.*, f. i. p. 640.
[2] *Brit. Med. Journal*, April 16, 1877.
[3] *Internat. klin. Rundschau*, No. 5, 1887.
[4] *Brit. Med. Journal*, May 16, 1885.

bandage. Hæmorrhage was checked, but death by syncope took place on the tenth day. The case proved to be one of acute disseminated tuberculosis, so that death was almost inevitable. The necropsy showed that communication between the false aneurism and the bronchus was closed, rendering it probable that had the patient survived long enough, complete solidification would have been effected. In extreme cases this procedure might be repeated.

Theodore Williams by means of a syringe with a fine-drawn point injected 20 grains of *tannic acid* into the lung itself, attempting to reach the cavity containing the ruptured aneurism. The hæmorrhage was entirely arrested. Richardson[1] advises injection of *hydrogen dioxide saturated with tannin.*

Betz, having noticed in a case of hæmoptysis that respiration was greatly quickened, and that there was greater expansion in the left subclavian region than in the right, applied over the left apex a two-pound sand-bag. This gave prompt relief to the breathing, and the hæmorrhage ceased within twenty-four hours.

NIGHT-SWEATS.—When general measures fail to control this unpleasant and often weakening symptom, and special interference is deemed advisable, the agent to which resort may usually be had with the utmost confidence is *atropine sulphate* (DaCosta and J. C. Wilson[2]). One of the best methods of administration is to dissolve half a grain in half an ounce of water, and let the patient take a certain number of drops at bedtime, beginning tentatively with four, and increasing the dose nightly by one drop until the desired effect is produced, which will usually be accomplished by seven or eight drops. If, however, so much as ten drops at a single dose should, after four successive nights, be ineffectual to check sweating, the dose is best divided; five drops being given two hours before bedtime, while the size of the other dose, to be taken at bedtime, is ascertained by trial. After the effect has been maintained for a week or ten days, the dose should be reduced by one drop. If this still prove effective, further diminution by a drop may be tried after four or five days, and so on until, if possible, the drug is dispensed with or given only every second or third night.

If atropine should prove inefficacious, *agaric acid* (or agaricin) may be tried. The dose is from $\frac{1}{8}$ grain to $\frac{1}{4}$ grain, one, two, three, or more times daily as may be necessary. *Homatropine*[3] has been given in doses of 2 grains in pill or $\frac{1}{4}$ grain by injection. The maximum dose is stated as from $\frac{1}{2}$ grain to 1 grain, by injection. The unpleasant effects of atropine (dryness of the throat, etc.) are said not to be produced.

[1] *Lancet*, April 4, 1891. [2] Wilson, *Philada. Med. Times*, Oct. 19, 1872, p. 34.
[3] Fronmüller, *Memorabilien*, cited in the *Med. Record*, April 22, 1882.

Strychnine (a full dose at night) is sometimes useful. Brunton[1] attributes this to its action on the respiratory centre. If there should be produced too great activity, continuing during the day, he tries to remedy this by adding *opium.*

Picrotoxin (gr. $\frac{1}{60}$, at bedtime or earlier) may be given in a single dose, or two doses if one should fail. *Pilocarpine hydrochlorate* (gr. $\frac{1}{32}$ to gr. $\frac{1}{4}$) sometimes proves useful temporarily. *Camphoric acid,*[2] which, according to Hare,[3] is superior to all other drugs used for this purpose, may be given in doses of from 15 to 60 grains during the twenty-four hours; preferably toward nightfall, in one 30-grain dose, which is also soporific. It is supposed to combat some product of bacillary action. Hare gives it in capsules.

Older remedies are *aromatic sulphuric acid* (fʒss in water, *t. i. d.*), *ergot* (fluid extract fʒss, *t. i. d.* or *p. r. n.*), *zinc oxide* (gr. ij to gr. v, at night). *Dusting* with *zinc oxide* or *zinc salicylate* at bedtime, and *sponging* with *tepid water* containing *dilute sulphuric acid* or *alcohol* and *quinine* or *tincture of belladonna* (fʒij *ad* Os), are useful expedients, and may render drug-giving unnecessary.

Nicolai[4] sponges with a solution of *chloral hydrate* (ʒij) in brandy and water (each one gobletful), and if this fails a shirt that has been wet with the same solution and dried at a moderate heat is put on the patient during the night, and when removed the patient is wiped dry. *Hamamelis* has been used both internally and as a lotion.

Potassium tellurate in pill (gr. $\frac{1}{3}$ to gr. $\frac{2}{3}$) has been used with good results by Neisser.[5] In larger doses, if used for some time, it will disturb digestion, and it imparts an unpleasant odor to the breath.

Pope[6] recommends a decoction of cinquefoil (*Potentilla Canadensis*), of which the patient drinks *ad libitum.*

Cough.—Cough in phthisis is not always to be checked. It should be sufficient, especially on rising in the morning, to get rid of the noxious materials in whole or in part. Hence, from time to time the use of stimulating expectorants, especially *terpin* or *terebene,* and a combination of the *ammonium salts,* is often extremely useful. Unproductive cough, however, cough that disturbs sleep, or cough after meals, giving rise to vomiting, may need prescription. Routine prescriptions should not be employed, but the remedy be adapted to the individual case. *Compressed air inhalations* will usually increase cough at first, and afterward diminish it by expulsion of irritating materials. The various *sedative and antiseptic inhalations* (*ethyl iodide, chloroform,* and

[1] *Pharmacology, etc.,* 3d ed., Philada., 1889, p. 443.

[2] Leu, *Centralbl. f. klin. Med., Therap. Gaz.,* Apr. 15, 1890; Combemale, *Bull. gén. de Thér.,* Jan. 15, 1891.

[3] *Medical News,* April 4, 1891.

[4] *Gaz. degli Ospitali,* July 15, 1885, cited in the *Medical News,* Aug., 1885.

[5] *Wiener klin. Woch.,* June 5, 1890.

[6] *Therap. Gaz.,* Aug. 15, 1887.

the like) are of great service in this connection, especially at night. The Yeo respirator, with ten to twenty drops of chloroform, may be put on at bedtime and worn during sleep. *Cherry-laurel water* as a vehicle for mixtures used in the Oliver vaporizer is likewise sedative. *Codeine* (gr. $\frac{1}{8}$ *q. 2 h.*), *ammonium bromide* (gr. v–x), *spirits of chloroform* (gtt. xx–xxx), *morphine acetate* (gr. $\frac{1}{8}$ *q. 2 h.*), *dilute hydrocyanic acid* (gtt. ij–v), *bromoform* (gtt. v), are among the best ingredients for sedative mixtures, and may be used singly or in combination. *Syrup of wild cherry* is often a good vehicle. I place more reliance, however, on the inhalations. Patients should go to bed early, as already stated, and their cough mixture, if it contain an opiate, be given at bedtime. It is best to avoid opiates, however, especially if there be renal difficulty. The food given during the night will help to control cough, as will the milk punch in the morning.

Insomnia, or disturbance of sleep, is often due to cough, and will be relieved by relieving its cause. If due to fever, the cold applications will subdue it. If due to want of elimination, the evacuants will be indicated. If due to weakness, tonics may relieve it. When it is to be treated as a symptom and by palliation, I know of nothing better than 5 grains of *chloral*, with 5 grains of *sodium bromide*, in syrup of *wild cherry* and water at bedtime. *Sulfonal* is sometimes useful (grs. x in hot water (D. D. Stewart) at bedtime), but may cause delirium. Other hypnotics may be tried.

Diarrhœa.—The diarrhœa due to indigestion or simple fermentation yields readily to corrective measures. That due to ulceration and lardaceous degeneration is often extremely obstinate. *Regulated diet*, *creasote*, or *carbolic acid* (gtt. ij) and *bismuth subnitrate* (gr. xv) in glycerin flavored with peppermint; *salol* (gr. v), *thymol* (gr. iij), *naphthol* (gr. v), *naphthalin* (gr. v), *bismuth salicylate* (gr. x), may be used in any case. *Silver nitrate* (gr. $\frac{1}{8}$) or *silver oxide* (gr. $\frac{1}{4}$) is sometimes useful when there is ulceration. When all these fail, *astringents* (of which logwood is one of the best) and *opiates* may be employed. I have sometimes controlled an obstinate diarrhœa of the last stage of phthisis by a pill consisting of *thymol*, gr. iij, *morphine sulphate*, gr. $\frac{1}{8}$, and *atropine sulphate*, gr. $\frac{1}{200}$, made up with *soap*. The dose is one pill three times a day or oftener, as necessary. *Aromatic sulphuric acid* is often quite efficacious. *Lead acetate* (gr. j) or *cupric sulphate* (gr. $\frac{1}{8}$), with *opium*, may be used if vegetable astringents do not answer. Small doses of *mercuric chloride* or of *arsenious acid* are sometimes useful. Bartholow prefers *Fowler's solution* and *deodorized tincture of opium*, both in small doses.

Opium and belladonna suppositories or *starch and laudanum enemata* may be used in conjunction with the stomachal administration of *salol*, *bismuth salicylate*, and other unirritating antiseptics.

Williams[1] advises when there is ulceration of the large intestine *enemata* consisting of a pint to a pint and a half of *linseed tea*, with from 30 to 40 minims of *deodorized tincture of opium*. When the stools are very fœtid the addition of *glycerin of carbolic acid* is recommended. *Creolin* (fʒj *ad* Oj) and saturated solution of *tannin in hydrogen dioxide* may be similarly employed.

Musser[2] gives in cases of colliquative diarrhœa *stimulants*, as burnt brandy, ammonia, or camphor. In ulcerative cases large doses of astringents, 30 to 60 grains of bismuth at a dose, have served him better than any combination of drugs. Debove[3] has given *talc* (*magnesium silicate*) in doses of from six to eighteen ounces a day. It is finely pulverized and thoroughly mixed with milk in the proportion of six ounces to the quart.

Pain.—Very often there is complaint of pain here and there in the thorax, which may indicate a localized pleuritic process or may be without discoverable relation to local changes. In the early stages of phthisis or pulmonary tuberculosis *blisters* may be applied over the seat of pain, or counter-irritation be made with *thermal point*, *iodine*, or *croton oil*, thus striking at the apparent cause of the symptom. When less active measures are desired, or later in the case, a liniment composed of equal parts of *camphor and chloral* has in my hands given most relief. Strapping the chest is advised by Roberts. When more generalized than local, more dull than sharp, *belladonna*, *mild capsicum*, or *thapsia plasters* may be applied. The last mentioned should not be allowed to remain on very long, but the spreading erythema or mild vesication it sometimes produces is not devoid of benefit. Sometimes *dry heat* or rubbing with *turpentine*, *chloroform*, or other liniments, or simply *gentle friction*, will give relief. Pains are not always confined to the thorax, but the same general principle will apply. The cause, if discoverable and removable, should be removed. Failing in this, should local measures be ineffective internal medication becomes necessary. *Opium*, *belladonna*, *hyoscyamus*, *cannabis Indica*, *conium*, *bromides*, *chloral*, or *Hoffman's anodyne* may be used singly or combined according to the extent, location, and character of the pain. When apparently due to or aggravated by general nervous failure I have seen relief follow the use of *arsenic* and of *strychnine*, and have often found *cocaine* dissolved in *dilute hydrobromic acid* and *syrup of wild cherry* a useful potion.

Vomiting requires attention to the cause. If due to gastro-intestinal irritation from undigested food, the attempt must be made to remedy this by treatment already detailed; in addition to which *carbolic acid*, *charcoal*, *creasote and bismuth*, *iodine*, *sodium sulphocarbolate*, and

[1] *Op. cit.*, p. 410. [2] *Loc. cit.* [3] Cited *N. Y. Med. Journ.*, July 7 1888.

similar antiseptics may be given. "*Lavage,*" if the throat is not too irritable to permit it, may at once put a stop to long-continued vomiting from this cause. I usually add chloroform-water to the solution and administer bromides for a day, and cocaine or hydrocyanic acid fifteen minutes before the operation, which is best done in the early morning before breakfast. When due to laryngeal irritation, *cocaine*, locally applied by spray or otherwise, just before the meal, is sometimes of service. *Lozenges* of *cocaine* and *fruit jelly*, *insufflations* of *morphine* and *bismuth*, *tannin* and *iodoform*, or other sedatives, and *astringent applications* may serve a good purpose. When vomiting is provoked by cough, *opium*, *morphine*, *codeine*, *diluted hydrocyanic acid*, or *diluted hydrobromic acid* may be so given as to produce its maximum effect at mealtime.

When weakness is the cause, *strychnine sulphate*, *caffeine*, *erythroxylon*, *alcohol*, *aromatic spirit of ammonia*, or *bitter tonics* may control the symptom. Bartholow advises the use of *picrotoxin*. Morning vomiting with or without cough may be prevented by a cup of hot coffee, hot milk punch, or egg and sherry before rising. *Amyl nitrite* (♏iij) with *ammonium carbonate* (gr. v) in glycerin and alcohol—a combination suggested by B. W. Richardson for other conditions—has been very useful in my hands in controlling the vomiting of gastric irritability and of exhaustion in phthisis, especially when there has been pain of a spasmodic character in the epigastrium. *Tincture of cardamom* or other carminative may be added.

Whatever be the cause of the vomiting, a *mustard plaster over the epigastrium* and *ice applied to the nape of the neck* are sometimes useful in checking it. So too is the ingestion of *hot water* in large quantities before meals, and the administration of *ice* and *iced food*, *koumyss*, *Vichy water*, and *iced champagne*. *Cocaine* (gr. $\frac{1}{8}$, 15 minutes before meals) and *diluted hydrocyanic acid* (gtt. ij, half an hour before meals) are often efficient palliatives. *Predigested foods* are applicable in all cases.

Œdema of the lower extremities is one of the most distressing of late complications. Diuretics can do little to relieve it; *caffeine*, *sparteine*, *strophanthus*, and *digitalis* are admissible, but salines are not. Elevation of the limbs and careful bandaging are required. Sedatives and astringents, such as *lead-water* and *laudanum*, *hamamelis*, *iodoform*, *collodion*, and the agents previously mentioned, may help to control local pain and redness. *Itching* is best relieved with a lotion or ointment containing a small percentage of *carbolic acid*, and I have found *extract of stramonium* a useful addition to thin vaseline or lanolin carbolized ointments. *Starch poultices* are sometimes grateful. The *albuminuria* which is present, and sometimes the cause of the œdema, is best treated by restricting the diet to milk, with an occasional

allowance of ordinary beef-tea. The plan is difficult to carry out, however. Williams had milk specially prepared, the albumen being reduced to 1 per cent., leaving it practically whey and cream, and this gave him good results.

Phlebitis is best treated by *rest* and the application of *heat*. Williams employs fomentations of flannel wrung out in hot water, sprinkled with laudanum, and applied to the limbs under oiled silk; and paints the track of the inflamed veins with *extract of belladonna* and *glycerin* to relieve the pain. When the trouble is localized, *iodine* applications are wonderfully useful. Lymphangeitis may be similarly treated.

Bed-sores should be prevented, if possible, by carefully watching the skin and placing the patient on a suitable bed. At the Brompton Hospital light spring beds have taken the place of water-beds. The red but unbroken skin may be treated with a diluted extract of *witch hazel* or a lotion of *water and alcohol* (1 : 4), with or without *alum* or *borax*. Ointments of *iodoform* or *zinc* with *belladonna* or other anodyne may be used. *Ichthyol* has seemed to answer well in some cases. Musser[1] mentions, among useful drying powders, *borax*, *rye flour*, *fuller's earth*, *zinc oxide*, *bismuth salts*, *iodoform*, and *starch*, and recommends for painful erythema a powder of *iodoform* 1 part, *zinc oxide* 2 parts, *bismuth subnitrate* 2 parts, *starch* 4 parts. Astringent and sedative solutions in addition to those mentioned are *zinc sulphate*, *carbolic acid*, or *alum* (gr. xx *ad* Oj) in water. *Iodoform in ether and collodion* is sometimes preferable to any other application, and if the sore be at all threatening I resort to it at once. When the skin is broken a circular air-cushion or a similar one of down should be used to protect the part from pressure. It may be dressed with *iodoform collodion*, the film of collodion being an advantage as a protection, or may be dusted with *iodoform*, *zinc oxide*, *bismuth subnitrate*, *bismuth subiodide*, or the like, sometimes mixed advantageously with a little *tannin*.

The Final Stages of Phthisis.

Musser[2] has called attention to the necessity of careful and minute solicitude concerning symptoms in detail after all hope of cure has been given up; in order not only that the patient's suffering shall be relieved, but that he shall not feel himself neglected and abandoned. I have referred in various connections to the different symptoms and their management, and have nothing further to say, other than to emphasize the importance of the subject, and to endorse the words of my colleague, who, after detailing the therapeutic expedients he has found the most useful, adds: "It is quite certain, however, that the firm voice, the truthful countenance, the inspiring touch sustain and soothe in this trying passage through the valley of the shadow of death."

[1] *Med. News*, Oct. 15, 1887. [2] *Ibid.*

In the foregoing pages I have endeavored to set forth, not completely, but comprehensively, the principles that should guide us and the methods on which we may rely in the treatment of a group of diseases having a mortality beyond that of any other. There are many useful methods, many potent drugs—none infallible, none universally applicable. As the famous painter said of his pigments, we must mix our food, our air, and our drugs "with brains."

It has been difficult to determine with how much elaboration or how much condensation to treat the different special topics in the limits of space assigned for the whole article; but the design has been to give, after the indispensable daily routine, greater prominence to good methods less generally known or applied and to be brief concerning matters of every-day knowledge. Pneumotherapeutic measures have been given great prominence, because of their supreme importance. I agree with Jaccoud that the physician who neglects these measures grossly fails in his duty toward the lives placed in his keeping.

Though an agent or a method do not "cure," it may relieve, or it may help to put the patient in condition to recover. To demand either of drugs or mechanical measures that they shall work miracles, or to reject that which accomplishes desirable ends, palliative or remedial, because it does not achieve impossibilities, is a practice as unscientific as it is, unfortunately, too common.

But success in treatment will not follow mere prescription, no matter how wise or how comprehensive the prescription may be. The physician must make sure that his advice is obeyed. Nothing but the most persistent and detailed questioning and the closest personal scrutiny will serve. Many a time have I been assured in all sincerity that my directions were strictly followed, and yet have found upon cross-examination that important minutiæ in diet or exercise—less frequently in drug-taking—were being neglected.

If I have underestimated the etiologic importance of bacteria, I have at least not erred in affirming our ignorance of their true rôle. As these pages leave my hands in the final proof, the researches of Prudden and Hodenpyl[1] "On the action of dead bacteria on the living body" open a new vista to reflection, and bid us be chary of too positive assertions concerning matters upon which we have as yet but a fraction of the evidence. I cannot but believe that closer study of the older writers and of the history of medical thought—and unthought—would save us from grievous error.

Though discouragement comes upon reading mortality statistics, hope returns upon learning that pathological studies and clinical observation concur in demonstrating that the fatal issue is not inevitable. It becomes

[1] *N. Y. Med. Journ.*, June 6 and June 20, 1891.

our duty, therefore, to try to save our patients by hopeful and persistent efforts after the disease has been developed; and still more, to save humanity at large by endeavoring to diffuse the knowledge of those simple means which may prevent its development; but we shall never succeed in the one or in the other effort if, losing sight of the constitutional foundation of the disease, we suffer ourselves to be led astray by the *ignis fatuus* of "specific medication."

In conclusion, I cannot do better than repeat the words of John Baron:[1] "By keeping the alimentary canal in a healthy condition—by freeing the mouths of the lacteals from obstruction—by apportioning the diet both in quantity and quality to the wants and powers of the system—by avoiding everything whereby these powers may be either too much excited or too much exhausted—by applying suitable means to subdue such local affections as may either have existed or may arise in the course of the complaint—by attending closely to the state of the skin—by promoting the healthy action of its extreme vessels by bathing of various kinds, by frictions, and by well-regulated and timely exercise, we may often witness the most gratifying results, ... instead of being compelled to watch the progress of fatal disorganizations which would probably have arisen had less rational and comprehensive views directed our practice."

[1] *An Enquiry illustrating the Nature of Tuberculated Accretions of Serous Membranes and the Origin of Tubercles and Tumours in Different Textures of the Body*, London, 1819, p. 156.

SCROFULOSIS AND RACHITIS.

By WALTER CHRYSTIE, M. D.

SCROFULOSIS.

Before entering into the subject of the treatment of scrofulosis a few words as to the nature of the diathesis are necessary. It should be understood that scrofulosis is not a *disease*, but a condition predisposing to certain disease-processes, and particularly to hyperplasia, tuberculous inflammation, and caseation of lymph-glands. It has no characteristic anatomical lesion or pathognomonic symptom, and when it is said that a person is scrofulous, it is meant that in him any peripheral inflammation, however slight, is prone to be prolonged, and that chronic inflammation of the lymph-glands into which the inflamed parts drain is almost certain to occur. Hence the inflammation about a carious tooth, an acute tonsillitis, or an excoriation of the scalp, which ordinarily would be a matter of a few days' duration, in a scrofulous person is prolonged, and causes tenderness and tumefaction of the cervical lymph-glands. Furthermore, the scrofulous offer a peculiarly favorable soil for the growth and multiplication of tubercle bacilli: a slight bronchitis in a scrofulous individual may open the way for the entrance of the bacilli, and be the starting-point of phthisis; and for the same reason many of the inflammations to which the diathesis predisposes are tubercular. It is this tendency to tubercular disease which make the management and treatment of a scrofulous child or adult extremely important, for by proper care the tendency may be thrown off and the normal resistance to the inroads of the bacillus tuberculosis acquired.

Prophylaxis.

The prophylaxis of scrofulosis should begin before birth by careful attention to the health of the mother during pregnancy, particularly if she has any previous history of scrofulous or tubercular disease. No special measures are required at such times, but all abnormal symptoms of pregnancy, such as excessive vomiting, diarrhœa, albuminuria, etc., must be treated promptly on the lines laid down in the textbooks on

obstetrics. The woman's nutrition must be kept as nearly perfect as is possible.

In children whose parents have suffered from any of the manifestations of scrofula, such as enlarged lymph-glands, or from tubercular disease of the lungs or bones, careful hygienic management and attention to every slight local inflammation, be it only a fissured lip or splinter under the finger-nail, is important, as by such attention the susceptibility to tubercular invasions may be entirely removed.

As most scrofulous persons are prone to attacks of catarrhal inflammation of the respiratory mucous membrane from chilling of the skin, and as such attacks are certain to be prolonged and frequently result in hyperplasia, tubercular infiltration, and caseation of the bronchial and mediastinal lymph-glands, the thickness and quality of the clothing must be carefully regulated, not only with reference to the season, but to minor changes in temperature. At all seasons the clothing should be of the material which is the poorest conductor of heat. Wool is not only a poor conductor, but also absorbs water with more readiness than any other material; hence with the body clothed in wool there is but little chilling of the surface by evaporation. According to Parkes,[1] "when dry woollen clothing is put on after exertion the vapor from the surface of the body is condensed in the wool, and gives out again the large amount of heat which had become latent when the water was vaporized." Softness of texture is a requisite in the under-clothing, for the scrofulous usually have delicate and easily-irritated skins, and harsh clothing is a frequent cause of erythema, eczema, and secondary glandular tumefaction. In the writer's experience the under-clothing known as the "Jaeger all-wool" fulfils the requirements, although a small amount of cotton in the fabric is not a serious disadvantage. Next to wool, silk is the best material for the under-clothing, but it has no marked advantages and its expensiveness precludes it from general use. There should be three sets of under-clothing—moderately thick for winter, intermediate for spring and autumn, and thin for summer. The shirts should button well up to the neck, and the sleeves must reach nearly to the wrists, the drawers of course extending to the shoes. It is not very unusual to find an infant whose skin is so delicate, particularly in the axillary regions, that even the softest wool is irritating, and in a few days causes erythema. This may be prevented by the free use of powdered talc, but it is much better to place next to the skin a shirt of the finest and lightest linen; rarely after this is applied will irritation be produced. Diapers should be changed as soon after they become wet as possible, not only to avoid chilling, but to prevent dermatitis of the perineal region from the irritation and poulticing effect of the urine. After exertion, in both children and adults, if

[1] *Hygiene*, 6th ed.

there is even slight moisture of the skin, it is well to remove all the clothing in a warm room, rapidly rub the body surface with a damp sponge, then with a soft, warm towel, and put on dry clothing. Indeed, in scrofulous children it is good practice habitually to change the clothing in the middle of the day.

Bathing.—Bearing in mind the extreme sensitiveness of the scrofulous to the effects of cold, the importance of carefully regulating the temperature of the baths is evident. Tub-baths should be entirely avoided; sponge- or shower-baths are sufficient for cleanliness, abstract but little heat, and as a rule are gently stimulating, whereas tub-baths in persons whose general nutritive activity is impaired are almost invariably followed by blueness of the extremities and an uncomfortable sense of chilliness and depression.

The proper temperature of the bath must be determined for each case, the guide being the lowest temperature that is promptly followed by reaction. In most cases this temperature will be found to be between 85° and 90° Fahr. in winter and 70° and 80° in summer. The temperature of the room in which the bath is taken should be not less than 72°. The process of bathing must be completed in from one to two minutes, and the body surface should be immediately rubbed with a soft warm towel, and afterward with the naked hand. It is well then for the patient to practise vigorously for a few moments some of the light calisthenic exercises. As to the proper time of day to bathe, in the majority of cases immediately after rising in the morning is preferable. A bath at night, particularly a cool sponge-bath, is sufficiently stimulating to interfere with sleep, whereas if taken in the morning the invigorating effects continue throughout the day.

Sea-bathing is undoubtedly of value to the scrofulous, perhaps partly from the small amount of iodine in sea-water, but chiefly because the salts increase the activity of the cutaneous glands, and because the bather is actively exercised. Jacobi writes that "salt water is preferable to plain water, and sea-bathing to either." Treves thinks that the effects of sea-bathing are chiefly mental, and asserts that it is absurd to bathe in artificial sea-water. D'Espine[1] has studied the effects of sea-air and bathing upon 308 children between the ages of four and a half and fifteen years, suffering from various scrofulous (tubercular?) affections, sent to the Mediterranean coast of France. Each child received about forty-five baths during a period of six weeks. Forty-eight cases were cured, 215 improved, 44 were unimproved, and 1 died.

Casse[2] claims that in many cases residence at the sea-shore, without either medical or surgical treatment, is sufficient to cure scrofulous dis-

[1] *Revue méd. de la Suisse Romande*, Sept., 1888.

[2] *Bulletin de l'Acad. Royale de Méd. de Belgique*, Jan., 1888.

ease. Many other writers, chiefly French, have advanced indubitable evidence that sea-air and bathing are valuable resources in the treatment of scrofulous affections. Many of the good effects are undoubtedly due to other factors, such as change of climate and scene, rest, regularity of meals, etc.; but the writer is convinced that salt baths stimulate nutrition, and is in the habit of directing scrofulous persons to add a small amount of sea-salt to the bath once or twice a week.

Surf-bathing has one very serious disadvantage—namely, that the bather is tempted to remain in the water so long that his cutaneous circulation is depressed and his extremities and lips become blue—a condition which of course interferes more or less with nutrition, and which is carefully to be avoided by the scrofulous. In children under six or eight years of age surf-bathing is not admissible.

Climate.—Next to the dietetic management, the most important matter in the treatment of a scrofulous child or adult is the selection of a suitable climate. No absolute rules for climatic treatment can be laid down, but in general it may be said that dryness, a large proportion of sunshine, and an equable temperature are essentials. Practically, the climates best suited to the treatment of phthisis are also those most appropriate for the scrofulous, and for more detailed directions than can be given here the reader is referred to the articles on "Tuberculosis" and "Climate."

Here let it be said that sanitaria, hotels, and boarding-houses frequented by consumptives should be carefully avoided by the scrofulous. Even if the etiological relation of the bacillus to tuberculosis is not established, in scrofulosis the tissues are peculiarly receptive to the causes of tuberculosis, and few will deny that some of these causes are increased by the aggregation of tuberculous persons. A scrofulous person suffering from bronchitis and living in an infected house is extremely likely to develop pulmonary phthisis; whereas, the same person living in pure mountain- or sea-air may pass through many attacks of bronchitis, none of which will leave any sequelæ.

The efficacy of sea-air in eradicating the scrofulous diathesis and its manifestations is admitted by all writers, and has been especially dwelt upon by Deligny,[1] who made a large number of observations upon scrofulous children treated in L'Hôpital de Berck on the coast of France. Frederick Treves[2] also writes that the records of the Margate Infirmary for Scrofula support the fact that sea-air possesses a curative influence upon scrofula, by showing a large number of cures and by a still larger number of cases of marked improvement; but he adds that "the greatest advantage is observed in instances of acquired struma, in cases where the disease has developed in the purlieus of a

[1] *De l'Adenopathie cervicale chez les Scrofuleux*, Thèse de Paris, 1879.

[2] *Scrofula and its Gland Diseases*, New York, 1882.

great town, and in those patients, in fact, to whom sea-breezes and outdoor exercises offer the most striking possible contrast to their previous surroundings."

Cases will occasionally be met with which do not improve in a coast climate, or which improve exceedingly slowly notwithstanding the utmost care in the selection of diet. Such cases will often improve rapidly if removed to a dry, moderately elevated mountainous region.

It is extremely difficult, and often impossible, to determine in a given case which climate will be the most beneficial. Treves thinks that the cases which do not improve at the seaside are usually those with a "phthisical tendency," as well as many cases of eczema, some cases of strumous ophthalmia, and a few cases of lupus. The writer's experience has been that cases in which there is marked anæmia, muscular debility, or exhaustion from the presence of the complications, such as glandular suppuration, bone disease, etc.—in other words, cases with well-marked tubercular disease excluding pulmonary phthisis—usually improve more rapidly in sea-air, and that cases of the scrofulous diathesis alone are better in mountain-air.

Many cases will gain in weight and appearance in a coast climate for a few months, then come to a standstill or even retrograde. Under such circumstances removal inland will usually be followed by renewed improvement. Indeed, in some cases frequent changes in climatic surroundings are necessary in order that the improvement may be continuous, and in all cases a week or two at the sea-shore can do no harm preparatory to a more prolonged sojourn in a mountain climate.

As a winter sea-shore climate the western coast of Florida possesses many advantages, there being a greater number of cloudless days than on any part of the Atlantic coast. During the winter months the temperature is very equable, seldom falling below 50° Fahr. There are also many facilities for outdoor amusements, such as fishing, boating, and shooting; and a reasonable amount of amusement is important in the climatic treatment of any disease.

Atlantic City, on the New Jersey coast, is an excellent winter resort, although of course much colder than the Florida coast. The temperature is higher during the winter than that of most northern sea-coast resorts, partly owing to the fact that a branch current of the Gulf Stream approaches here within sixty miles of the shore, and also because the direction of the Gulf Stream opposite Atlantic City is such that the prevailing ocean-winds must pass from three hundred to five hundred miles over the warm current. Land-breezes, however, are about the same as elsewhere on the New Jersy coast, but the total amount of wind is nearly 30 per cent. less. The rainfall is said to be less than at any other point on the Atlantic coast of the United States, with the exception of Portland, Maine.

The winter climate of San Diego, on the coast of Southern California, is mild, and, although rather damp, is beneficial to many cases of scrofulosis. Lindley[1] has called attention to the Conchilla Valley in the eastern part of San Diego county, California. The valley is 360 feet *below* sea-level, the atmosphere dry, and the pressure of course somewhat increased. Good effects in the treatment of phthisis have followed residence there.

Excellent summer resorts are Cresson, Pennsylvania, the Adirondack Mountains and surrounding region, the pine belt of New Jersey, and the mountains of Virginia. The mountains of Georgia and North Carolina are suitable regions in both summer and winter.

Diet.—Dietetic management is so important in the treatment and prophylaxis of scrofulosis, particularly in infants, that the writer will dwell somewhat at length upon the subject, believing that often the future health of the individual depends alone upon the methods of feeding during infancy and early childhood.

Until within the past few years it was very generally insisted upon that infants of tubercular or scrofulous parents should be nursed at the breast, and it has even been contended that well-marked scrofula in the mother is no contraindication to her nursing her child, and that unless she be phthisical it is safer not to resort to artificial food until the child has reached the age of several months. Undoubtedly, human milk, even from a scrofulous woman, is better than improperly selected and prepared artificial food, and it is also true that normal human milk is much better pabulum for infants than the most carefully prepared artificial food; but in most instances the milk of a scrofulous woman will not have the normal amounts of fat and albuminoids. Fat, an abundance of which is important to healthy infants, but vastly more important to the scrofulous, will usually be deficient in quantity. Hence, when the question arises of how to feed a scrofulous infant, it must first be decided whether the mother's health will warrant the drain upon it of lactation. If this is decided in the affirmative, a careful estimation of the fats and albuminoids in her milk must be made, and if either varies much from the normal amount artificial food or a wet-nurse must be resorted to.[2]

[1] *Annual of the Universal Medical Sciences*, vol. v., 1889.

[2] Nias (*Lancet*, November 15, 1890) suggests the following method of estimating the amount of fat and albuminoids in milk, which he considers sufficiently accurate for clinical purposes: Add enough liquor potassa to the sample of milk to render it distinctly alkaline; place in a test-tube, boil, and set aside in a warm room for a few hours. The fat will rise to the surface, and the amount may be estimated by a graduated rule placed at the side of the tube. To determine the amount of albuminoids remove the layer of fat with a pipette, add sufficient acetic acid to the remainder to render it acid, boil, and again set aside in a warm room. All the albuminoids will be precipitated, and may be estimated in the same manner as the fat. The process would be much facilitated by using a test-tube graduated in hundredths.

Taking the milk analyses of Meigs[1] as on the whole the most accurate that have been made, the fat in milk for a scrofulous child should not vary much from 4.2 per cent. (the normal amount) or the albuminoids from 1 per cent. In some cases, although chemical analysis shows a normal proportion of the various constituents of the mother's milk, the child does not thrive upon it, but gains weight slowly or not at all, and shows evidences of imperfect digestion. Under these circumstances a wet-nurse may be resorted to if one can be found who fulfils all the well-known requirements; but with the additions of the past few years to our knowledge of artificial foods and feeding, breast-feeding can no longer be considered an essential in the management of scrofulous infants.

In selecting a food for a scrofulous child the indications are exactly the same as in the case of a normal infant—namely, to give that which chemistry shows is the nearest in composition and in behavior under various tests to the food provided by nature.

Escherich has shown that milk drawn from the breast of a healthy woman into sterilized receptacles can be kept for some days without undergoing fermentative or putrefactive changes; in other words, normal human milk is free from micro-organisms. The importance of this condition is now universally recognized, and sterility may be considered an essential quality of all foods for infants. In the scrofulous its importance is, if possible, greater than in normal infants, for in them the introduction of a few of the bacilli of tuberculosis is very likely to result in tabes mesenterica or tubercular enteritis. Milk can be rendered sterile by one method only—namely, by maintaining it at a temperature of 212° Fahr. for from ten to thirty minutes in the various forms of sterilizers, which are too well known to need description.

The artificial food that approaches the nearest to human milk in its chemical and physical properties is the mixture of cow's milk, lime-water, and milk-sugar proposed by Meigs, or some of its modifications. Meigs's mixture consists of 10 cc. of cream, 5 cc. of milk, 10 cc. of lime-water, 15 cc. of water, and 2.2 grammes of milk-sugar.

Meigs's original directions for preparing this food were somewhat elaborate and troublesome, but subsequently[2] he described a much simpler method, chemical analysis showing that the amount of the various constituents was about the same by either method. The simplified method has the very great advantage that cream does not have to be obtained separately, for in cities the cream furnished by dealers is always either twelve or twenty-four hours older than the milk, and hence is more likely to become sour: "One quart of good ordinary

[1] *Milk Analysis and Infant-feeding*, Philadelphia, 1885.
[2] *Arch. of Pediatrics*, Dec., 1889.

milk is placed in a high pitcher or other vessel, and allowed to stand in a cool place for three hours; then one pint is slowly poured off from this, care being taken that the vessel is not agitated, the object being to obtain the upper layer of fluid, rich in fat, and leave the lower, comparatively poor, portion behind. When the child is to be fed, there are taken of this weak cream three table-spoonfuls, of lime-water two table-spoonfuls, and of sugar-water three table-spoonfuls, the sugar-water being made in the proportion of eighteen drachms of milk-sugar to a pint of water." This of course makes only four ounces, sufficient for infants less than two or three months old. For older infants larger amounts of the mixture must be given, still retaining the relative amounts of the ingredients.

Holt[1] has objected, with reason, that Meigs's mixture is much more strongly alkaline than human milk, and that the taste of the lime-water is evidently unpleasant to many infants. For these reasons he dilutes the lime-water two-thirds, the dilution rendering the mixture slightly but distinctly alkaline. Holt also uses cream obtained by the centrifugal process, diluted one-fourth with water, which contains more fat, raising the percentage of fat in the mixture to 4, that of the original mixture of Meigs being 3.50.

There has been a tendency to believe that in a sterilized mixture which is chemically nearly identical with human milk we have reached perfection in artificial infant-foods. To this we desire to protest, without in any way undervaluing the importance of thorough sterilization. The prolonged high temperature to which the milk is subjected has no parallel in nature, and must necessarily produce certain changes. The writer has more than once seen a child thriving on unsterilized Meigs's mixture become dyspeptic and constipated when the same food was given sterilized, and he has been obliged to assume the risks of giving raw milk in order to avoid the more imminent dangers of gastro-intestinal catarrh and malnutrition. Furthermore, careful observation is convincing that to be properly nourished an infant must take a slightly larger amount of sterilized than of unsterilized milk. These disadvantages are exaggerated in the feeding of infants with an inherited scrofulous diathesis, in whom complete digestion and thorough nutrition are necessary. The experiments of Raudnitz, Vasilieff,[2] and others have shown that in both man and the lower animals larger quantities of boiled than of unboiled milk are necessary to maintain the body-weight. Vasilieff's experiments upon healthy men were apparently carefully conducted, and show that the amount of non-assimilable albuminoids is about 5 per cent. greater in boiled than in unboiled

[1] *Cyclopædia of Diseases of Children*, vol. i. p. 323.
[2] *Provincial Med. Journ.*, January, 1890.

milk, and that nearly 50 per cent. less fat is appropriated from boiled milk, the deficiency of assimilable fat being a serious disadvantage to the scrofulous.

Hirst,[1] in searching for the cause of these changes, had a number of analyses of sterilized milk made, the results of which indicate that a temperature of 212° Fahr. produces very decided alterations in the albuminoids, fat, and sugar. The most important changes are in the fat, and consist in the freeing of a very small amount, and an alteration of the envelopes of the remaining fat-globules which lessens their tendency to coalesce. On churning sterilized and unsterilized samples of milk it was found that with the latter butter was formed in one-third of the time required by the former. Assuming, then, that the difficulty in digesting sterilized milk lay in toughening of the albuminoid envelope of the fat-globules, Hirst logically concluded that partial predigestion of the envelope would render the escape of the fat materially easier. To determine the truth of this he churned small quantities of milk and cream mixture which had been partly predigested by pancreatin and sodium bicarbonate, with the result that butter formed freely in less than four minutes. In a similar sterilized but not predigested mixture no butter was produced for twelve minutes, and then only in small quantities.

Theoretically, then, partial predigestion of milk and cream mixtures before they are sterilized would seem to be a great improvement in our methods of infant feeding, and the inference is supported by the results in twenty-one infants in the Philadelphia Hospital fed on this plan; and we have no hesitation in affirming that the method should be tried in all artificially-fed scrofulous infants that do not thrive and gain weight as they should. The directions for preparing the mixture and for feeding are as follows:

"1. Have ten nursing-bottles prepared clean every morning.

"2. Take

Cream	5 ozs.
Milk	2½ ozs.

"3. Put in skillet; add pancreatin powder; heat over alcohol flame for six minutes; stir and sip constantly; *do not overheat.*

"4. Of this mixture, put in each bottle 6 drachms (for a 2-oz. bottle). Use funnel.

"5. Add to each bottle 10 drachms sugar solution.

"6. Stopper the mouth of each bottle with dry, baked cotton, and sterilize for twenty minutes.

"7. Set aside to cool.

"8. Before use, put bottle in warming-cup; apply nipple immediately before giving it to infant.

[1] *The Medical News*, Jan. 31, 1891.

"Make sugar solution by dissolving 1 ounce sugar of milk (one powder) in a pint of warm water.

Age.	Interval.	Number of feedings in 24 hours.	Amount of food at each feeding.	Total amount in 24 hours.
1st week	2 hours.	10	1 oz.	10 ozs.
2d to 4th week	2 hours.	9	1½ oz.	13½ ozs.
2d to 3d month	3 hours.	6	3 ozs.	18 ozs.
3d to 4th month	3 hours.	6	4 ozs.	24 ozs.
4th to 5th month	3 hours.	6	4–4½ ozs.	24–27 ozs.
6th month	3 hours.	6	5 ozs.	30 ozs.
8th month	3 hours.	6	6 ozs.	36 ozs.
10th month	3 hours.	5	8 ozs.	40 ozs.

"The pancreatin powder, for the quantity indicated on the card, consists of

℞. Pancreatin, 2½ grains;
Bicarbonate of sodium, 5 grains."

There are a certain number of scrofulous infants in whom fat is deposited with unnatural ease and rapidity, and often at the expense of the other tissues. In such cases it may be well to reduce slightly the amount of cream. For instance, in the mixture of Hirst 4 or 4½ ounces of cream, instead of 5, might be given. But the weight of the child must be carefully watched, and should it cease to gain it is better to return to the original amount of cream. Ass's milk and goat's milk, both of which have been recommended, are not suitable foods for the scrofulous. The former contains too little fat, the latter an excess of both fat and albuminoids.

During and after the period of weaning milk must still be the chief article of diet, and in the city should be sterilized, or at least well boiled, as soon as received, in order to reduce to a minimum the danger of tubercle bacilli entering the system by way of the intestines. In the country, where the cows from which the milk is received can be watched, sterilization of milk for children older than one year can hardly be considered necessary. In most cases between the fourteenth and eighteenth month it is well to add a small amount of starch to the diet of scrofulous children. At first almost any of the many preparations of the cereals may be given, those being finally selected which are digested most readily. The stools must be watched, and if they become clay-like in consistence, if they are covered with an excess of mucus, or if particles of undigested food appear, the best preparation for that case has not been given or has been given in excess.

"Wheatena,"[1] given in the form of a thin mush, has proved very satisfactory in the writer's hands. It is said to contain all the elements

[1] Made by the Health Food Company.

of the wheat-berry but the husk—in most other preparations of wheat the layer of gluten-cells is removed with the husk or bran. In wheatena the starch-granules have already been ruptured by heat, and only a few moments' cooking is necessary.

"Farina," also a preparation of wheat, is less nutritious than the former, much of the gluten having been removed with the bran, but it is easily digested and in cases with a tendency to diarrhœa is preferable to any of the preparations of whole wheat.

Corn in all forms must be excluded from the dietary of scrofulous children before they reach the age of three or four years. Although its fat-forming and heat-producing powers are greater than those of any other cereal,[1] it is not easily digested, and in many cases its employment will be attended with flatulence and indigestion, perhaps terminating in diarrhœa.

Oatmeal is largely used, but as a rule is not well borne by scrofulous children, whose digestive powers are seldom strong. Still, it may be given, particularly in cases with constipation, if it is thoroughly boiled and causes no symptoms of indigestion.

Bread-jelly is useful as an occasional change from mushes, but has a tendency to constipate if given freely. It is prepared by pouring boiling water upon stale bread and allowing it to soak for an hour. The water is then removed, fresh water added, and the whole boiled until a thick mass forms. On pouring off the excess of water and cooling, a jelly-like material remains which may be eaten with milk or sugar.

Bread from twenty-four to forty-eight hours old, if properly made, is a useful food for scrofulous children. If, however, it is improperly made—that is, if the fermentation caused by the yeast has not been carried far enough, resulting in "heavy" bread,—or if it has been carried too far, causing the formation of lactic, butyric, and acetic acids —it is an exceedingly bad food. Bread made of so-called gluten flour, which, however, always contains starch, is more nutritious than that made of ordinary flour, and is generally easily digested. It is particularly useful in cases with an excessive deposit of fat.

Between the twelfth and eighteenth months, or about the time that the first four molars appear, animal food should be cautiously added to the dietary, beginning with not more than a table-spoonful of well-made beef-tea daily. Beef-tea, although it contains only small amounts of albuminoids, is an excellent introduction to the use of meat. During the first few weeks of its administration the beef-tea may be made by the ordinary domestic process—namely, covering a pound of finely-chopped lean beef with a pint of water, and allowing it to stand in a warm place for two or three hours, and straining off the disintegrated

[1] Yeo, *Food in Health and Disease.*

meat. After a few weeks, however, the presence of a larger amount of soluble albuminoids is desirable, when the beef-tea should be prepared by the following method, a modification of that originally suggested by Liebig: one pound of finely-minced lean beef is macerated for one hour in a pint of water containing 15 grains of sodium chloride and 5 drops of dilute hydrochloric acid, at a temperature of 100° Fahr. The whole is then filtered through a fine sieve or through cheese-cloth, the residue being washed with half a pint of fresh water. The filtrate is transparent, has a not unpleasant taste, and contains a considerable amount of albuminoids. A child of two years may take two or three ounces of this daily, with stale bread, rice, or a well-baked mealy potato.

Adams[1] suggests as a modification of this a process by which the albuminoids are precipitated by heat. It consists of "mincing 1 pound of lean beef, and adding a pint of cold water and 10 drops of dilute hydrochloric acid. This should stand for from two to three hours, with occasional stirring. It should then be left to simmer for fifteen or twenty minutes, when it will be ready for use."

As a scrofulous child develops, larger amounts of fat should be given than in the case of robust children, care being taken not to give the fat in such large quantities as to produce indigestion. It must also be remembered that comparatively small amounts of fat produce a sense of satiety much sooner than starches and nitrogenous food, and for this reason the fat should be given at or near the end of the meal, in order that the child may take sufficient food.

A scrofulous child should not be sent to school at an early age: the confinement in a more or less constrained position, the bad ventilation, and the insufficient light of nine-tenths of our school-rooms interfere with nutrition and development. Moreover, a large proportion of school-children hurry from the breakfast-table and take little or no exercise until the middle of the day, when they eat a cold lunch and perhaps exercise to excess for half an hour. Returning home in the afternoon, they are given a warmed-over dinner, and probably at six or seven o'clock a fourth meal, which is followed by an hour or two of study. Such a routine is a most pernicious one, and in a scrofulous child is certain to lead to gastro-intestinal indigestion and deterioration of the general health, and the tissues become more and more a favorable soil for the growth of tubercle bacilli.

After the first few years of a child's life its own likes and dislikes may be consulted in selecting the most suitable food, as they are often useful indications of what is required, provided that the stomach is in a fairly normal condition. Not that a child should be given just what it wants; but if, for instance, meat should be markedly distasteful, it

[1] *Cyclopædia of Diseases of Children*, vol. i. p. 338.

should not be given in as large amounts as in the case of a child who craves meat and does not care for vegetable food. The administration of fats, however, is an exception to the rule, as they are usually disliked by scrofulous children, yet must be given in some form.

In adults the treatment of scrofulosis is based on the same general plan as that of children—namely, surrounding the patients with the best attainable hygienic conditions. All sedentary indoor occupations must be avoided, and, if possible, the patient should live in the country, either near the sea or in a dry mountainous district. The strictest precautions against exposure to cold must be observed, and the digestive tract kept in good working order. A prolonged sea-voyage is often of benefit.

The diet, as in the case of children, must contain an abundance of fat. From one to two quarts of milk should be taken daily if it does not cause constipation or that group of symptoms known as biliousness. Unfortunately, there are many cases of scrofulosis in which milk is not well borne, its ingestion for a few days causing constipation and anorexia, with a coated tongue and foul breath. These symptoms may often be avoided by taking the milk as hot as it can be swallowed without discomfort, and midway between meals, or by adding a pinch of common salt to each glass of milk. In other cases slight dilution with water will render the milk easier of digestion. Lime-water has been much used for the same purpose, and it doubtless acts, as indicated by the experiments of Meigs,[1] in causing the casein to be precipitated in the stomach as a fine curd, which can be more readily acted upon by the gastric juice than the tough, coarse curd ordinarily produced. According to Porter, two grains of inspissated ox-gall, administered shortly before the milk is taken, will render it easily digested. Many of the proprietary infant foods, while not to be recommended for the purposes intended by their manufacturers, when added to milk render it more easily digested by adults and also possess considerable food value. A table-spoonful of Mellin's or of Nestlés' food dissolved in an ounce of hot water and added to a glass of milk makes a palatable drink, and one that is more easily digested than pure milk, doubtless by causing the casein to be precipitated in a fine curd. In a few cases milk cannot be taken unless partly predigested by means of pancreatin.

Koumyss, or fermented milk, originally prepared in Russia from mare's milk, but now largely made from cow's milk, has been strongly recommended in the treatment of phthisis, and is an excellent food for the scrofulous. In the fermentation of the milk about one-half of the milk-sugar is converted into carbonic acid and alcohol, the result being an effervescent beverage with a slight cheesy taste, a liking for which is readily acquired by most persons. For the scrofulous koumyss made

[1] *Loc. cit.*, p. 72.

from cow's milk is preferable to that made from mare's milk, as the latter contains only about one-fourth as much fat as the former. True koumyss contains about 1.5 per cent. of alcohol, that made from cow's milk considerably less. Unless it is decidedly repugnant to the palate, koumyss is readily digested by the most easily disordered stomach. It is distinctly diuretic and diaphoretic.

Cream may be taken in doses of a table-spoonful two or three times daily, but frequently diminishes the appetite, and thus prevents the taking of a sufficient amount of food. It is always more easily digested if diluted with an equal amount of water or of lime-water. The addition of a small amount of sherry, brandy, or whiskey has been recommended, but in the writer's experience the addition of alcohol in any form interferes with the digestibility of cream, probably in the same way as heat—namely, by toughening the albuminoid envelope of the oil-globules. It is better to use cream as only a substitute for cod-liver oil, to be given when the latter cannot be taken. In the administration of fats their minute subdivision renders them more easily digested than if given solid. The fat of beef or mutton may be repulsive and cause indigestion if eaten in pieces, yet if thoroughly distributed through some other article of food, pulverized, as it were, it is easily taken and completely digested.

Constipation is a common and serious complication of scrofula. Constipation in itself seriously interferes with the eradication of the scrofulous diathesis, and moreover in many cases it indicates imperfect digestion from improper food. Practically, constipation is due to one of three causes—namely, improper food, ineffectual peristalsis, and deficient secretion of the intestinal juices. The cause in each case is often difficult to determine, and often can be decided upon only after therapeutic tests have been made. From whatever cause, if long continued, it interferes with nutrition and demands relief.

The removal of this complication in breast-fed infants is usually an extremely difficult problem, demanding close and patient observation. The amount of fat and albuminoids in the mother's milk must be estimated, and if either varies much from the normal the propriety of substituting bottle-feeding must be considered, the decision resting upon the presence or the absence of symptoms of indigestion. If the composition of the mother's milk is nearly normal, and yet the infant continues constipated, one bottle of slightly predigested artificial food daily may be sufficient to cause more regular action of the bowels. In cases in which this fails the addition of "whole-wheat gluten" flour to each bottle will sometimes give excellent results. A table-spoonful should be added to a pint of water and boiled for about three hours, or until a thick custard-like paste remains. Of this a tea-spoonful may be added to the nursing-bottle just before feeding.

Oatmeal-water, often used to overcome constipation, is less efficient than gluten flour, and is much more apt to cause gastric and intestinal disorders.

Frequently, constipation in infants is relieved by giving them a few ounces of water daily. A pinch of salt given alone, and followed by a swallow of water or added to the milk, is often beneficial, particularly if flakes of undigested casein appear in the stools. Phosphate of sodium, in doses of from 10 to 20 grains daily, given in the child's milk, is efficient in all cases; it is in case of slight intestinal catarrh, however, in which it is most useful. Sugar, molasses, and honey, each of which has been recommended, must not be given to infants under a year old, for an excess of sugar is certain to cause acid fermentation, perhaps followed by diarrhœa, and then by aggravation of the constipation. In older children bread and molasses (not *syrup*) may be given each day, provided that there are no symptoms of gastric indigestion. Constipation in the scrofulous is almost invariably relieved, and often cured, by the use of cod-liver oil.

Suppositories of cacao butter, given once daily for a month or two, are useful in not very obstinate cases of constipation due to atony of the lower bowel. They act probably by exciting the smooth muscular fibres of the lower bowel to contraction, which, as in other parts of the body, results in increase of muscular power, and by lubricating the fæces and permitting them to pass with less resistance. In obstinate cases gluten suppositories are much more efficient. Glycerin suppositories should be used only to relieve acute constipation or in chronic cases when it becomes absolutely necessary to open the bowels. The same may be said of glycerin enemata. The daily adminstration of an enema of tepid water has been recommended by Jacobi and others, and may be resorted to if the foregoing measures fail.

Massage of the abdomen is an important part of the treatment of constipation in the scrofulous. In infants it can seldom be carried out properly, but even if imperfectly performed it is of service, and should be systematically employed. The movements should consist chiefly of deep kneading and sharp tapping, beginning over the cæcum and following the course of the large intestine, continued for ten minutes at a time twice daily. Electricity, also not well adapted to the treatment of infants, is a valuable therapeutic agent in the treatment of constipation from intestinal atony in adults. (For the details of its application the reader is referred to the preceding article on Electricity.)

Drugs specifically directed to the relief of constipation in scrofulosis are of little use, except in that form caused by lack of power of the smooth muscular fibres of the intestine, but in the latter form nux vomica or its alkaloid, strychnine, is invaluable, but must be given in full doses and persistently. Our own preference is for the sulphate of

strychnine. A child of six months may take from $\frac{1}{300}$ to $\frac{1}{200}$ grain three times daily; a child of one year may take $\frac{1}{150}$ grain. In older children and adults the dose should be carefully increased until there is distinct exaggeration of the knee-jerk, when it may be slightly reduced and given for several months. In children between ten and fifteen years of age the proper dose will be between $\frac{1}{60}$ and $\frac{1}{30}$ grain; in adults even as much as $\frac{1}{12}$ grain may be required.

Medicinal Treatment.

Cod-liver Oil.—First in the list of medicinal agents for the elimination of the scrofulous diathesis must be placed cod-liver oil, partly a food and partly an alterative, depending for its properties not only upon the fact that it is an oil, but upon the combination of substances which it contains. De Jongh's analysis of cod-liver oil showed the presence of glycerin, oleic, margaric, butyric, and acetic acids, biliary principles, iodine, chlorine, traces of bromine and phosphorus, and a peculiar substance termed *gaduin*. The value of the oil in scrofulous affections has been attributed to the iodine, but there is rarely more than 1 part of this element in 2000 parts of oil, and from the light-colored oil it is often absent. Gaduin is apparently inert, and each of the remaining substances is present in too small amount to be therapeutically active. The experiments of Naumann some years ago proved that cod-liver oil passes through animal membranes, both living and dead, more rapidly than any other oil, the experimenter attributing this peculiarity to the presence of the biliary principles. Other experimenters have confirmed the accuracy of these observations. Still others have asserted that cholesterin is the only biliary principle present in cod-liver oil, and Brüke's experiments apparently show that the ready diffusibility of the oil is due to the presence of fatty acids. Careful experiments have also shown that cod-liver oil is very easily oxidized.

The remarkable nutritive and alterative properties of cod-liver oil, then, are almost certainly dependent upon the ease with which it is absorbed and oxidized, and upon the combination of substances which it contains.

It is in the treatment of scrofulosis and the early stage of tuberculosis that the effects of cod-liver oil are the most manifest, but to obtain good results it must be given carefully, the amount and the method of prescribing being suited to the condition of the patient's digestion. It is worse than useless to give half an ounce when but half a drachm can be assimilated.

To cases with well-marked scrofulous diathesis, but with no evidences of tubercular involvement, the persistent administration of cod-

liver oil, if the hygienic surroundings of the patient are good, will almost certainly result in complete eradication of the tendency to tuberculosis. In scrofulous ophthalmias and skin lesions the results of the use of cod-liver oil, combined with appropriate local treatment, are often brilliant. In enlargement of the lymph-glands and tonsils the oil should be given, although its direct influence upon the diseased structures is seldom very distinct. In such cases it is given more with the object of increasing nutrition and preventing further complications than to cure the lesions that may be present. In the protracted acute bronchitis of the scrofulous, cod-liver oil is by far the most valuable remedy we possess, and even in the earlier stages, while the cough is still tight, it often acts as a soothing expectorant, and may be used if the temperature is not elevated and the stomach is not irritable. It is also valuable in all stages of rhinitis common to scrofulous persons.

Cod-liver oil is much used in the treatment of caries and necrosis of bone in the scrofulous, but in these diseases it has seemed to the writer to be of little use. In severe cases there is always more or less fever, the stomach is irritable, and diarrhœa is not infrequent, any one of which interferes with the action of the oil. If given at all, it should be in small doses with wine or spirits, withholding it if the tongue becomes coated, if there is nausea or diarrhœa, or if there is failure of the appetite.

The dark-brown or black "Straits" oil was formerly used in preference to the less offensive "shore" oil, De Jongh particularly advocating it on account of the supposed larger amount of biliary principles, and because he believed that the products of decomposition greatly increased its therapeutic value. Whatever its advantages, however, they are more than outweighed by its taste and smell, which are so very offensive that few people are willing to take the crude oil, or, taking it, can assimilate it.

Both the light-colored and dark-colored oils are adulterated and imitated, but to what extent it is impossible to determine. A German writer has asserted, on what authority we know not, that in America a spurious cod-liver oil is made by macerating herring in olive or cotton-seed oil—for a few hours if a light-colored oil is desired, longer if a dark-colored. Whether this be true or not, cod-liver oil should be obtained from a reliable manufacturer.

According to the U. S. Dispensatory, the most certain test for the purity of oil is the presence of an odor resembling that of shoe-leather. Absence of the biliary colors on adding a strong acid proves that the specimen is not cod-liver oil, but the presence of the colors merely shows that the oil contains biliary principles and is no test of purity.

The administration of cod-liver oil is nearly always attended with

difficulty at first, and great care must be exercised or the disgust may become unconquerable. In cases in which the repugnance is great it is well to begin with very small doses—from ten to twenty drops three times daily—until the patient becomes somewhat accustomed to the taste. The amount may then be gradually increased until within a month a dessert-spoonful is taken at a time. It is seldom advisable to give more than a table-spoonful three times daily, as more than this is not absorbed, and is almost certain to interfere with digestion. In some cases no more than a tea-spoonful can be given without diminishing the appetite and producing eructations of gas tasting and smelling of the oil. A few cases, however, will be found which acquire a liking for the oil, and can take two or three ounces daily without evidences of gastric derangement and with benefit. It is usually best given about an hour after eating, when it is emulsified with the food and is then easily absorbed. In some cases it is better tolerated if given in a single dose at bedtime.

Many methods of masking the taste of cod-liver oil have been devised. In adults, if alcohol is indicated, the oil may be floated on ale or beer, covered with froth and swallowed quickly, the taste of the oil not being perceived. It may also be floated on whiskey and water, strong coffee, or lemon-juice, and quickly gulped down. The taste is scarcely noticeable if just before taking the dose the mouth is washed out with undiluted whiskey or brandy containing two or three drops of oil of peppermint. The same effect is obtained by holding a peppermint lozenge in the mouth just before taking the oil, and with children this method is usually successful. Common salt may be used for the same purpose, but is less efficient. In several instances the writer has been able to give the oil by requiring the patient to hold a 1 per cent. solution of cocaine hydrochlorate in the mouth for a few moments previously.

Emulsions of cod-liver oil are largely used, and on theoretical grounds are believed by some to be more readily absorbed and less likely to disagree than the pure oil; but practically better results are obtained by administering the pure oil. One reason for this is doubtless that it is difficult to make an emulsion containing more than 50 per cent. of oil, and patients are seldom willing to take the necessarily larger dose. There are a few persons, however, who seem unable to take the oil in any other form, and in such cases it is better to use an extemporaneously prepared emulsion than those that are prepared in large quantities, for cod-liver oil deteriorates with age, and mixtures made by the wholesale are likely to be a year or more old before reaching the consumer. The oil is best emulsified either with mucilage of tragacanth or with yolk of egg and glycerin. The following are formulæ of excellent emulsions:

℞. Cod-liver oil,	6 ounces;
Oil of wintergreen,	1 drachm;
Mucilage of tragacanth,	2 ounces;
Orange-flower water, sufficient to make	12 ounces.

Any agreeable essential oil may be used in place of the oil of wintergreen, and if for children it is well to add two or three drachms of sugar.

℞. Cod-liver oil,	6 ounces;
Oil of wintergreen,	1 drachm;
Chloroform,	2 drachms;
Glycerin,	
Yolk of egg, of each	5 drachms;
Orange-flower water, sufficient to make	12 ounces.

The second mixture is not so thick as the first, and is for that reason preferred by some.

The so-called pancreatized emulsions as sold in the shops are unsatisfactory in practice, but it is said that two ounces of finely-chopped pancreas added to a gallon of oil, thoroughly mixed and strained off, makes an excellent emulsion. An emulsion may also be made by thoroughly mixing equal parts of cod-liver oil and a thick extract of malt, such as "maltine."

Lefaki[1] gives the oil emulsified with an equal quantity of lime-water and flavored with lemon syrup, vanilla, or anything desired by the patient. The mixture is permanent and readily assimilated, and, it is said, may be given even if there is diarrhœa.

The following is Carlo Pavasi's method of masking the taste of the oil: 1000 parts of cod-liver oil, 50 parts of ground coffee, and 25 parts of animal charcoal are placed in a flask and heated for an hour over a water-bath. The mixture is then set aside in a cool place, and stirred occasionally for three days, when the oil is filtered off and is ready for use. A cod-liver oil jelly may be prepared by means of isinglass, but is not very palatable. Oil of bitter almonds added in the proportion of three drops to the ounce masks the taste of cod-liver oil very thoroughly.

In cases in which administration of the oil by the mouth must be abandoned inunctions may be resorted to, and from them well-marked therapeutic effects can be obtained. A drachm previously warmed, should be poured into the palm of the hand, and well rubbed into the skin of the abdomen and the inner side of the thighs. From two to four drachms may be thus used at a time, rubbing for about five min-

[1] *Journal de Méd. et de Chirurgie*, May, 1889.

utes for each drachm of oil. H. A. Hare[1] asserts that if a small quantity of bile-salts be added to the oil absorption by the skin is much more rapid.

Von Mering,[2] acting on the hypothesis that the virtues of cod-liver oil depend upon its ready diffusibility and emulsification, due to the presence of free fatty acids, proposed as a substitute free from unpleasant smell and taste olive oil to which has been added 5 per cent. of oleic acid. This he terms *lipanin*, and claims that large quantities of it may be given without deranging the stomach or intestines, and with rapid deposition of fat and improvement in health in those who are emaciated from disease. Hauser[3] and a few others have also reported good effects from the use of lipanin, and, although it has not come into general use, it is worthy of trial in cases in which cod-liver oil is not well borne. Hauser gives it in doses of from one to three tea-spoonfuls three times daily, after meals, and finds that it causes rapid gain in weight. That the lipanin is absorbed is shown by the very small quantity of fat and fatty acids that can be recovered from the stools.

Iodine, either alone or in combination, has been used in the treatment of scrofulosis, and more particularly in the treatment of glandular enlargements, for many years, and it is certainly a valuable remedy in cases of enlarged lymph-glands if they are not acutely inflamed and if they have not undergone cheesy degeneration. Bartholow writes that "the preparations of iodine are effective only when simple hypertrophy of the lymphatic glands has taken place; if they have undergone caseation or have proceeded to suppurate, no medicine has any influence over them." There is no clinical evidence to prove that any drug has the slightest specific effect in causing absorption of cheesy masses, but that iodine causes reduction in size of cirrhotic or infiltrated glands is certain; and, moreover, it has a specific effect upon the scrofulous diathesis, occasionally as marked as its effect upon tertiary syphilis.

In the inflammations of the skin of the scrofulous iodine is often serviceable, its value usually being proportionate to the chronicity of the affection. Eczema in its earlier stages will be almost certainly aggravated by the use of iodine.

In scrofulous rhinitis and ophthalmia and in some cases of hypertrophied tonsils it is a valuable remedy, but in these conditions also acute symptoms contraindicate its use.

Either iodine itself or potassium iodide is preferable in the rather exceptional cases of scrofulosis without anæmia, while the iodide of iron should be used in cases of anæmia.

The tincture of iodine should never be administered by the mouth,

[1] *Therapeutics*, 2d edition, Philadelphia, 1891.
[2] *Therapeutische Monatshefte*, February, 1888.
[3] *Zeit. f. klinische Med.*, Bd. ix., 1888.

as the iodine is precipitated on reaching the stomach and causes indigestion and pain. The only eligible preparation of pure iodine to administer is Lugol's solution or the *Liquor Iodi Compositus* of the U. S. Pharmacopœia, of which twenty drops contain one grain of iodine and two of potassium iodide. To children one drop of this, well diluted, may be given three times daily, rapidly increasing, if it is well borne, to five drops. More than this it is seldom advisable to give. Adults may begin with five drops, and increase to twenty, three times daily. Milk is a good vehicle in which to administer the solution, a glassful being only slightly flavored by five drops of the solution. As with any other preparation of iodine, the slightest evidence of gastric derangement is an indication for the immediate temporary withdrawal of the remedy.

Syrup of the iodide of iron is more used, and probably more useful, in the treatment of scrofulosis than is any other preparation of iodine. Its indiscriminate employment is, however, often productive of disastrous gastric derangements. It is suited to those cases in which there is well-marked anæmia—the majority of cases. It must be given in small doses and for a long time, and discontinued whenever it is not well borne by the stomach. The best time to take it is about two hours after meals, when the process of digestion is far advanced, but the stomach not yet empty. To children not more than from 3 to 5 drops should be given at the outset, slowly increasing to from 10 to 12 drops. Adults can take proportionately larger doses.

Phosphorus has been recommended in the treatment of scrofulosis, chiefly by Jacobi, who believes that he has seen much benefit from it. "Scrofulous tissues," he writes, "with their rapid decay and new formations have indeed the characteristics of cell-proliferation, which perishes speedily because it is not sustained by a healthy connective tissue. The latter is formed by the internal administration of minute doses of phosphorus." Phosphorus is certainly of some value in the treatment of scrofulosis, but holds a secondary place to iodine and the iodides. It may be prescribed in the form of the 1 per cent. *Oleum phosphoratum* of the Pharmacopœia, beginning with from one-half to one drop, according to the age of the patient. Cod-liver oil is usually indicated in cases to which phosphorus is given, and makes a good vehicle in which to administer it.

The *phosphates* have been recommended in the treatment of scrofulosis, particularly by Beneke, on the ground that in many cases of scrofulosis there is an excess of phosphates in the urine, indicating a waste that should be artificially supplied. The reasoning is perhaps not entirely logical, but phosphates are often used in scrofulosis, and sometimes apparently increase general nutritive activity.

Phosphate of calcium is particularly useful in cases of suppurating

scrofulous ulcers, and in such cases should be given in doses of from one to three grains three times daily. Larger doses are unnecessary, as only small amounts are absorbed; and, indeed, Ringer suggests that large doses might be dangerous, as the salt is unaffected by the intestinal secretions, and hence liable to form concretions. Owing to its more ready solubility, the lactophosphate of calcium is a better preparation to use than the simple phosphate. The syrup may be combined with cod-liver oil and the syrup of the iodide of iron as follows:

℞. Syrup of iodide of iron,	1 drachm;
Cod-liver oil,	1 ounce;
Syrup of lactophosphate of lime,	1 ounce;
Lime-water, sufficient to make	4 ounces.

Dose, from one to four tea-spoonfuls. To be well shaken.

Chloride of calcium was formerly extensively prescribed in the treatment of scrofulous gland disease, and its use has lately been revived by Mays,[1] who thinks it valuable in cases of "pale rickety children who have swollen cervical glands, poor appetite, coated tongue, and constipation, and in whom there is a general indication of malassimilation." In the "glandular swellings of adults," a somewhat vague term, he thinks that the resolvent powers are marked, although in such cases it requires a longer time, "and its action is facilitated by the simultaneous application of iodine." Coghill writes still more enthusiastically of the drug, and has seen "chronically enlarged and indurated glands which absolutely amounted to deformity, and which had resisted all previous treatment, yield, even in adults, to the administration of this salt." It may be given in doses of from 2 to 20 grains, according to the age of the patient, and, as its administration must be prolonged, water is a better vehicle than syrup, which tends to produce acid dyspepsia.

Sulphide of calcium is strongly recommended by Ringer in the treatment of suppurating cervical glands, on the ground that it hastens the elimination of the pus and cheesy deposits. After the abscesses have opened and are discharging a small amount of unhealthy pus, the edges of the ulcer being indurated, Ringer thinks that sulphide of calcium "renders the discharge more abundant, thick, creamy, and healthy, considerably hastens the evacuation of the scrofulous matter which prevents the healing of the wound, and at the same time softens the round indurated edges, so that the sore heals much more quickly." In long-standing cases the drug must be administered for several weeks before the effects become manifest. In the writer's experience sulphide of calcium has proved a valuable adjunct in the treatment of

[1] *Arch. of Pediatrics*, August, 1888.

suppurating scrofulous glands. In children it is best to begin with from $\frac{1}{20}$ to $\frac{1}{15}$ grain, increasing to $\frac{1}{10}$ or even $\frac{1}{5}$ grain. Adults may take at the outset $\frac{1}{4}$ grain, increasing to $\frac{1}{2}$ grain, Ringer giving in some cases as much as 1 grain. It may be prescribed in gelatin capsules, in solution, or in the form of powder. The most convenient and satisfactory method is to prescribe it in powders, each of which should be dissolved in a glassful of water just before it is taken. It cannot be kept long in solution, as the sulphide is rapidly oxidized. In solution the taste is simply that of an ordinary sulphurous mineral water.

Anæmia is frequently associated with scrofulosis, and, as elsewhere, is an indication for the administration of iron. If there are glandular enlargements, nasal catarrh, or suppurative otitis media, syrup of the iodide is generally the best form in which to administer iron; but if merely the scrofulous diathesis is present, without distinct lesions, iodine is not required, and some other preparation of iron should be used, that being given which causes the least gastric disturbance and constipation. This is not the place to discuss the merits of the different compounds of iron, each one of which will be sometimes found to be the best in certain cases.

Alcohol must be used with great care in the treatment of scrofulosis, as in other long-continued conditions, and should not be given at all unless there are complications demanding it. The only indications for it are suppuration or tubercular inflammation, with fever and general symptoms more or less resembling hectic. These being present, small doses of well-diluted spirits should be given daily.

Quinine is indicated by the same conditions which require alcohol, and should also be given in cases which seem to have arisen from malarial poison, as well as in those complicated by intermittent fever.

Arsenic has been used with asserted success in the treatment of scrofulosis, but it is difficult to understand what effects it should have, and it is not improbable that the successful cases in which it was used were those in which malarial poisoning was the cause of the scrofula.

The remaining remedies which have been used as specifics require only mention. They are pipsissewa, stillingia, sarsaparilla, sanguinaria, potassium chlorate, the salts of barium, and mercury.

Treatment of Scrofulous Glands.—The treatment of scrofulous disease of the lymph-glands may be considered under two heads—namely, medicinal, including external applications, and surgical. The general medicinal treatment of enlarged glands does not differ materially from that employed in the treatment of the diathesis itself, and is elsewhere considered in this article.

External applications have been, and doubtless always will be, largely used. Good effects are obtained from them in cases which have not advanced to caseation, but it is doubtful if they ever reduce

to any extent caseated glands. *Tincture of iodine,* a time-honored application, is useful chiefly in subduing acute inflammation. It should be painted over a surface considerably larger than the swelling, but it should not be used so frequently as to cause marked irritation of the skin, else a new focus of inflammation is excited which may be followed by tumefaction of other glands. In children, and in adults in whom the skin is easily irritated, an ointment consisting of iodine 20 grains, iodide of potassium 5 grains, and lanolin 1 ounce is preferable to the tincture of iodine; it causes less local irritation, and probably sufficient iodine is absorbed from it to exert a specific action upon the disease.

Ichthyol has been strongly recommended by some surgeons in the treatment of glandular disease, but in a number of cases of both acute and chronic glandular enlargement in which the writer has used the drug no effects could be observed, and he cannot but think that its efficacy has been exaggerated. It may be used in the form of an ointment, with either lanolin or vaseline as a base, beginning with a strength of 5 per cent., and increasing to from 10 to 15 per cent. if it does not cause redness of the skin.

Emplastrum ammoniaci, and *emplastrum ammoniaci cum hydrargyro* containing sulphur and mercury, will sometimes cause reduction in the size of recently enlarged glands. The latter must not be used for long periods of time, as it may produce mercurial poisoning. The ointment of the iodide of lead is also a good application in recent cases. The injection of various substances into the glandular enlargements has been practised to a limited extent, but has nothing to commend it, and we are entirely in accord with Mr. Treves, who writes that it is an "uncertain and dangerous proceeding, especially for glands which are deeply seated."

In many cases marked reduction in the size of scrofulous glands may be secured by keeping the parts at rest, but this method of treatment is applicable only to cervical glands. In this region rest of the parts may be secured by wearing a wooden stock or collar or by the use of the splint devised by Mr. Frederick Treves, which consists of an upright attached to the back by means of chest- and waist-bands and a band passing around the forehead. To be of use rest secured in this manner must be persisted in for some weeks.

Should constitutional treatment and rest of the affected region fail to cause considerable reduction in the size of the tumors, surgical treatment must be considered, as the tubercular tissue may infect the system, and will certainly prevent elimination of the scrofulous diathesis.

Two operations are available—namely, erasion or scooping, and excision. Erasion is preferable in cases in which only one or two glands are affected, but should not be undertaken if a number of

glands are involved. It is performed by making a small incision through the capsule of the caseous mass, inserting a Volkmann's spoon, and thoroughly scraping away all softened tissue, the whole of course being done under antiseptic precautions. The parts should be kept rigidly at rest until cicatrization is nearly complete. Scraping is also applicable to cases with fistulæ leading to old glandular abscesses and to ulcers with thickened unhealthy bases and ragged edges. The operation has been objected to by Mr. W. Knight Treves,[1] on the grounds that it leaves an abscess-cavity, and that by this means it is difficult to remove all the diseased tissue. These objections hold in many cases, but if it is restricted to those in which only one or two superficial and softened glands exist, the operation is a proper one and is much less formidable than excision.

In cases with masses of caseated glands excision is the only operation that gives good results. The procedure is one requiring patience and care rather than special surgical skill. "The cardinal secret of success in these operations is to keep on the tumor—that is, to cut with the knife or to scratch with the grooved director through the bands of connective tissue which hold the gland down to the neighboring parts, doing this cutting and scratching directly upon the glands themselves at safe limits from the edge nearest to important structures."[2] If these directions are carefully followed, enormous masses, with prolongations extending into the supraclavicular fossa and surrounding the blood-vessels and nerves of the neck, can be safely removed. Cicatrization goes on with rapidity if the operation has been complete, if antisepsis has been perfect, and if the parts are kept at complete rest after the operation.

RACHITIS.

ALTHOUGH rachitis has no pathological relationship to scrofulosis, the one being a disease, the other a predisposition to certain diseases, the prophylactic and general hygienic management of each is almost identical, and the reader is referred to the preceding section on Scrofulosis for fuller discussion of the hygienic management of ill-nourished infants than can be given here.

The basis of pathology on which the rational therapeutics of rachitis rests has been apparently firmly established by Kassowitz to be a chronic inflammation of the bones and bone-forming tissues, with increased vascularization, insufficient deposit of lime-salts, removal of lime-salts previously deposited, and proliferation of cartilage-cells, the

[1] *Lancet*, October 5, 1889.

[2] J. William White, *Therapeutic Gazette*, April 15, 1890.

cause of these changes being some defect in nutrition which in many cases dates back to intra-uterine life.

Prophylaxis.

The starting-point of the disease not infrequently being in intra-uterine life, and due to some cause which impairs the health of the mother, particularly prolonged lactation, insufficient or improper food, and frequent childbearing, prophylaxis must begin with careful attention to the health of pregnant women. Should a woman be nursing an infant when pregnancy begins, it must be immediately weaned and placed on artificial food, for its own sake as well as for that of the unborn child. Strong meat soups, a moderately large proportion of meat, easily-digested vegetables, oatmeal, or wheaten gruel should form her dietary; in other words, she must not permit her stomach to waste its energies in endeavoring to digest food which does not assist in tissue-building.

Milk is so valuable a food during pregnancy that every effort must be made to give it. Should it cause symptoms of "biliousness," it may be diluted with lime-water, partly peptonized, or gruels made of oatmeal, barley, or any of the cereals may be added. In some instances hot milk is more easily digested than cold. Malted milk, as a rule, can be taken without causing gastric disorder, but most persons soon grow tired of it. William H. Porter writes that the administration of from 2 to 5 grains of inspissated ox-gall greatly assists in the digestion of milk. If possible, from 1 to 2 pints of milk should be given daily. Every means must be avoided to check excessive vomiting should it occur, and it is still more important to control diarrhœa.

Pregnant women who have borne children previously which suffered from rachitis should be given small doses of phosphate of calcium, for reasons that will be subsequently stated in considering the use of this drug. There is reason to believe that lingering traces of syphilis in the mother predispose to rachitis in her children; hence, if she has had any manifestations of syphilis during the four or five years preceding pregnancy, it is well to give potassium iodide, associated with iron if there is anæmia or with iron and cod-liver oil.

General Treatment.

Climate.—Climate has little or no specific effect on rachitis, although the disease is less frequent in warm and dry climates than in those which are cold and damp; hence when the disease develops in winter in northern climates, the patients should be taken to a warmer and drier region for two reasons—first, because they can get an abundance of fresh air and sunshine, which are more important by far than

drugs; and second, because a warm climate may have some specific effect on the disease.

All cases which develop in cities should if possible be removed to the country, where the surroundings tend to improve the general health, and where food, particularly milk, can be obtained fresh and free from adulteration. It matters little whether the region selected be on the sea-coast or inland, but improvement is often more rapid if a coast climate and mountain climate are alternated at intervals of one or two months.

Clothing.—A rachitic child, like one which is scrofulous, is extremely sensitive to low temperature, and exposure to cold is almost certain to be followed by a serious bronchitis or by intestinal catarrh; hence the clothing demands careful attention; but as the proper methods of dressing rachitic children are precisely the same as in the case of those suffering from scrofula, the reader is referred to the section on that subject for more detailed directions.

Bathing.—Special care is necessary in the bathing of rachitic children. They should not be immersed, but given a daily sponge-bath with cool water, the lowest temperature being employed that is not followed by blueness of the extremities. In many children a temperature of 80° Fahr. in summer and 85° in winter will be well borne. In others, baths of 80°, even in warm weather, will be followed by very imperfect reaction, the finger-nails remaining blue for an hour after the bath, even though the surface of the body be well rubbed. The so-called "hardening process" of plunging children in water at the temperature of the room immediately on rising in the morning should never be permitted by physicians, and in the case of rachitic infants such treatment is little short of murderous, exciting catarrhs or aggravating those already present, interfering with the nutrition of the skin, and causing dyspepsia from congestion of the digestive organs. In giving a bath the nurse should place a rubber sheet upon her lap, and over this an old and soft blanket. The child is then placed upon her lap, and water is freely dashed upon it, the head first being wet by means of a large soft sponge, the excess of water flowing into a basin between the nurse's feet. The child is then thoroughly dried, two towels being used, and briskly but lightly rubbed with the naked hand until the skin is pink. If the disease is at its height, roughness of manipulation must be avoided during the entire procedure, else deformities of the softened bones may be produced or exaggerated. The temperature of the room in which the bath is given should be between 70° and 73°, and there must be freedom from draughts. In winter it is of advantage to have an open fire before which the child is held while being dried and rubbed. An open register through which a current of warm air is flowing must be avoided,

the draught causing too rapid evaporation of the water. As a rule, the child's behavior will indicate whether the procedure is being properly carried out. If it cries or frets, the water is probably too cold or sufficient gentleness is not being exercised.

Food.—Improper food during the early months of infancy is a prolific cause of rachitis, and should there be any reason to suspect that an infant is not properly nourished, a careful investigation into the character and amount of its food is necessary. If the child is nursed at the breast, an analysis of the milk should be made, and if it does not correspond closely with normal human milk, artificial food must be immediately substituted. If the change causes diarrhœa or vomiting, or if it increases already-existing digestive disturbances, the substitution must be gradual, one bottle of prepared cow's milk being given daily for a few days, then two bottles, later three bottles, and so on until the bottle entirely supplants the breast. We have entered very fully into the subject of feeding of ill-nourished infants in the section on Scrofulosis, and as the same methods are applicable to rachitic children, the reader is referred to the preceding pages. Starches must not be given much before the end of the first year to infants who have had any symptoms of rachitis, and then in small amounts only. Indeed, with such infants it is safer to rely on milk alone, with perhaps small quantities of beef-juice, until the age of fourteen or fifteen months. From the tenth month the amount of water added to the milk must be gradually diminished, so that by the fifteenth month the mixture is only one-sixth water, a proportion which it is well to maintain for several months longer. Meat-juice is often useful toward the end of the first year, particularly in very anæmic cases, in which, although milk is fairly well digested, the bowels are sluggish, the appetite is poor, the heart weak, and the muscles flabby. The meat-juice may be prepared from good lean beef by rapidly browning the outside over a quick fire, and pressing out the juices by means of a lemon-squeezer. Valentine's meat-juice, well diluted, may be used, but seems to have no advantages over that freshly prepared. The home-made juice may be given in doses of a teaspoonful two or three times daily, Valentine's preparation in somewhat smaller amounts. Infants usually seem to relish it.

Medicinal Treatment.

In no disease is the number of remedies that have been recommended smaller than in the case of rachitis. Indeed, there are only two given for a direct effect upon the disease—cod-liver oil and phosphorus and its preparations.

Cod-liver Oil.—Nothing in therapeutics is established on a firmer basis than the great value of cod-liver oil in the treatment of

rachitis. As to why and how it acts we can only speculate. It certainly increases the nutritive activity of the organism, and if not given in excessive doses aids in the assimilation of all food-stuffs, besides being in itself a food. Further, it probably influences the blood-making organs, as suggested by Wood, and in anæmia increases the number of the corpuscles and the amount of hæmoglobin. It is doubtless by virtue of its stimulating effect on nutrition that it is of such marked benefit in rachitis. That it is invaluable there is no dissenting voice. To rachitic infants it must be given in small doses, 10 drops at first, gradually increasing to 1 drachm, or even more if diarrhœa or gastric disturbance is not produced. It may be administered pure or emulsified, as in cases of scrofulosis, and the writer has no hesitation in saying that all persons, both infants and adults, can take it if given in the proper manner; that is, in sufficiently small doses at first.

In many cases it is of advantage to supplement the administration of the oil by the mouth by inunctions. Clinical experience and the experiments of Randolph and Roussel prove that the skin absorbs the oil readily. According to H. A. Hare, the addition of a small amount of bile-salts increases its absorbability. The inunctions are usually made upon the abdomen. The infant should be in a warm room before an open fire or a stove, and, the nurse's hand being well warmed, two or three drachms of the oil can be rubbed into the skin, a few drops at a time, fifteen or twenty minutes being consumed in the process. The abdomen is then covered with a clean piece of light, soft flannel to protect the clothing.

Phosphorus.—In 1872, Wegner, in studying the physiological action of phosphorus, found that when continuously administered in small doses to growing animals it caused the bones to become much harder than normal, the cancellous tissue in some instances being entirely replaced by compact bone. In adult animals similar although less marked effects were observed. It was at once suggested to the experimenter's mind that phosphorus should prove useful in the treatment of rachitis, in which disease softening of the bones is the essential pathological condition—an excellent illustration of the practical application of experimental therapeutics, for evidence has rapidly accumulated that next to cod-liver oil phosphorus is the most valuable drug we possess for the treatment of this disease, and that it has almost a specific effect upon rachitic bone-changes.

Kassowitz, the most enthusiastic advocate of the phosphorus treatment, has given the drug in nearly 600 cases of rachitis, with a large proportion of cures. Mandelstam of Kazam administered phosphorus to 216 cases of rachitis, the ages of the patients varying from three months to four years, with the result that 120 cases were cured, 43

were benefited, in 30 there was no improvement, and in the remaining cases treatment was discontinued on account of intercurrent diseases. The remedy was given either in cod-liver oil or in the emulsion recommended by Kassowitz—viz. $\frac{1}{100}$ part of phosphorus, 15 of gum Arabic, 30 of almond oil, and 40 of water.

Anna Schabanowa reports 105 cases treated by phosphorus, the results being remarkably good in 6 cases, excellent in 32, fairly good in 39, poor in 22, and in 6 cases the symptoms were aggravated. Starker reports 23 cases treated by phosphorus in the clinic of Thomas of Freiburg, the drug being given in cod-liver oil and no other medication being used, although the diet was carefully regulated. In 15 cases ossification of the skull was hastened; in 9 cases deformities of the thorax were favorably influenced; in 21 cases there was improvement in the shape of the epiphyses; in 1 case spasm of the glottis diminished; in 15 cases sweating of the head lessened; in 11 cases the influence on deformed extremities was favorable; and in 18 cases the general condition improved, the improvement being noticed in from two to three weeks after beginning treatment. Vineberg quotes Soltmann, Meyer, Petersen, Sigel, Unruh, and Töplitz as having used phosphorus in the treatment of rachitis, their cases in the aggregate being about 1000. Each observer was convinced of the value of the remedy, many considering it a specific. Jacobi[1] believes that "by virtue of its irritating effect when given in small doses it acts as a tissue-builder, when in large doses a tissue-destroyer," and that it is useful in rachitis, particularly for the relief of craniotabes, which diminishes after a very few weeks of the phosphorus treatment. Many other observers might be quoted to prove that phosphorus is of great value in the treatment of rachitis, although from the reports of all it is evident that the number of cases in which it fails to do good is not small. Nor is this surprising, when it is considered that rachitis is not merely a bone disease, but a disorder of nutrition affecting more or less many tissues and organs, especially those of the digestive tract—a fact that is frequently lost sight of. The inference is evident that the more the disease is confined to the bony and cartilaginous tissues, the more should be expected from phosphorus, and, on the other hand, when there is gastro-intestinal catarrh, with an enlarged and possibly fatty liver, phosphorus cannot be expected to do good, and indeed is much more likely to increase the disease. Again, it is not improbable that in rapidly-developing cases the hyperæmia of the osseous tissues becomes a true inflammation, which phosphorus may aggravate unless given in very small doses. Thus this much-lauded and really valuable drug must not be regarded as a specific for rachitis, but only as a specific for the most serious of its manifestations—a remedy to be given with care, and withheld should

[1] *Archives of Pediatrics*, August, 1888.

gastro-intestinal symptoms increase during its administration. The possibility of fatty degeneration of the liver resulting from its use must not be forgotten, and, although the writer has been able to find no cases of this disease resulting from the therapeutic use of phosphorus, it is not an excess of precaution to percuss the liver frequently, and to withhold the drug should there be evidence of either enlargement or diminution in the size of the organ. Jaundice too should be an indication to abandon the use of phosphorus.

Phosphorus is best administered in solution in oil, the *Oleum phosphoratum* of the U. S. Pharmacopœia being an excellent preparation, consisting of a 1 per cent. solution of phosphorus in oil of almond. This is frequently prescribed in almond emulsion, as follows:

℞. Olei phosphorati, ♏xxx;
Misturæ amygdalæ, q. s. ad f℥iv.

Dose, one tea-spoonful, representing $\frac{1}{100}$ grain of phosphorus.

In cases of infants under one year old the writer usually directs a $\frac{1}{4}$ per cent. phosphorated oil to be prepared, and at first gives 1 drop of this in cod-liver oil, three times daily, rapidly increasing to 3 drops. Larger doses he rarely gives to infants under one year, and he seldom gives more than 6 drops ($\frac{1}{75}$ grain of phosphorus) to children of two years. Small doses are as efficient as large, and are free from danger.

Phosphates have been much employed in the treatment of rachitis, and the use of phosphate of calcium is supported by theory as well as by clinical observation and experiments upon lower animals. It is well known that in bone the subject of rachitic changes phosphate of calcium, which forms about 50 per cent. of normal bone, is much diminished in amount. Further, a number of observers, prominent among whom are Voit and Roloff, have noted that depriving animals of phosphate of calcium for a comparatively short time is followed by bone-changes similar to, if not identical with, those of rachitis. In one instance, quoted by H. C. Wood, the bone-changes were frequent in a herd of cattle, the hay upon which they were fed being found almost devoid of earthy salts. Bone-meal being added to their food, recovery followed.

Clinically, although the phosphate of calcium is often disappointing, in some cases it seems to hasten the re-ossification of softened bones. It should always be given to pregnant women who have borne children which became rachitic at an early age without discoverable cause. Phosphate of calcium may be administered in doses of from 2 to 5 grains, but it is extremely insoluble, and for this reason the syrup of the lactophosphate of lime is frequently employed in its stead. That this syrup is therapeutically equivalent to the phosphate of calcium is

an open question, but in some cases it certainly promotes hardening of rachitic bones. It may be given to children in doses of ½ to 1 fluid-drachm, and is often administered with cod-liver oil. Adults may take much larger doses.

Complications.

Digestive Disturbances.—The strictest watch must be kept upon the condition of the gastric and intestinal digestion in all cases of rachitis. Phosphorus, cod-liver oil, and indeed all therapeutic measures, are useless so long as an acid dyspepsia or an intestinal catarrh, with either constipation or diarrhœa, is permitted to persist. A case which is convalescent may relapse, the bone-changes becoming rapidly worse in a few days, from one injudicious meal, weeks being required to repair the damage done in a few hours.

Dyspepsia.—Dyspepsia preceding or developing in the course of rachitis is almost invariably of an acid character, and due very frequently to an excess of starch or sugar in the food. In artificially-fed infants it can usually be overcome by careful attention to the preparation of the food, restriction of the amount within proper limits, and regulation of the intervals between each meal. Not infrequently it is advisable to peptonize the milk slightly, but unless a gastric catarrh has been superinduced drugs will seldom be necessary.

Should there be gastric catarrh or if the symptoms of indigestion persist in spite of a proper dietary, drugs are necessary. Phosphate of sodium is then one of our most useful remedies, whether there be diarrhœa or constipation, and rarely fails to relieve such symptoms as acid eructations, a sensation of fulness after eating, and colic, and alone is often sufficient to effect a cure. It may be given to infants in doses of from 3 to 10 grains in water half an hour before each meal. Magnesia may be used with the same object, and has seemed to the writer to be especially indicated when, in addition to the acid dyspepsia, there is an excess of urates in the urine. It may be given in doses of from 2 to 5 grains. In cases with diarrhœa, nitrate of silver, given in plain water in doses of from $\frac{1}{20}$ to $\frac{1}{8}$ grain half an hour before each meal, is often more efficient. Subnitrate of bismuth is generally useful if constipation is not present, and in not a few cases in which there is diarrhœa with offensive frothy stools we have seen great relief follow the addition of a few grains of finely-pulverized charcoal to each bottleful of food. Light friction over the region of the stomach is usually beneficial, and the abdomen must be thoroughly protected against changes in temperature.

Diarrhœa.—Diarrhœa in rachitis demands prompt treatment: it is a drain which the patient cannot afford, and further it is an indication of imperfect digestion, which he can still less withstand. Like gastric indigestion, it is often due to improper feeding, and ceases at once when

a proper dietary is adopted. Medicinally, subnitrate of bismuth is the most generally useful remedy in persistent cases. It should be given in large doses if the diarrhœa is excessive—from 10 to 20 grains three times daily to a child of one year. If the stools are offensive, and if there is much tympany and borborygmus, naphthalin is a useful addition to the bismuth in doses of from 1 to 3 grains, but as a rule creasote is more efficient. The following is a useful formula in which to administer bismuth and creasote to children:

℞.	Creasoti (beechwood),	♏ij;
	Bismuthi subnit.,	ʒiss;
	Sacchar. albæ,	gr. xx;
	Pulv. acaciæ,	q. s.;
	Aquæ menthæ piperit.,	fʒss;
	Aquæ, q. s. ad	fʒij.—M.

Sig. One tea-spoonful two or three times daily. Shake well.

Constipation.—Like dyspepsia and diarrhœa, constipation in rachitic children is frequently due to improper food or to over-feeding, and often terminates in an explosion of diarrhœa, after which the previous condition becomes even more obstinate than before. In such cases the adaptation of the diet to the needs of the individual, and the use of phosphate of sodium or magnesia to neutralize excessive acidity of the stomach, will usually be followed by a gradual establishment of normal intestinal action, although the change may be hastened by the administration of small doses of fluid extract of cascara—from 1 to 3 drops three times daily—by abdominal massage, or by the use of glycerin or gluten suppositories, given at the same hour daily for one or two weeks. The addition of sugar or molasses, often advised in the treatment of infantile constipation, is not to be recommended in rachitis, in which an excess of sugar is prone to excite acid fermentation. If the stools are very dry, water, which under all ordinary circumstances should be boiled, will often be of great assistance in relieving the constipation. If the constipation has been of long duration, its relief is seldom so simple a matter, and often requires patience and persistent treatment, probably because intestinal atony and deficient secretion from all the intestinal glands, including the liver, are superadded. Here, after a suitable dietary is established, abdominal massage is the most important part of the treatment, and should consist chiefly of kneading and tapping, beginning at the right iliac fossa, passing in the direction of the colon upward to the left, and downward. Phosphate of sodium will be found valuable in most cases, stimulating the liver and intestinal glands. Strychnine sulphate is valuable, particularly in markedly "pot-bellied" cases—a condition which is produced not only

by the crowding downward of the abdominal organs by the contracted thorax, but also by deficient innervation. Small doses of fluid extract of cascara, combined with nux vomica and a simple bitter, such as gentian, are indispensable in many cases. The following formula is frequently used by the writer:

℞. Tr. nucis vomicæ, f℥ss;
Extract. cascaræ sagradæ fl., f℥vj;
Tr. gentianæ comp., f℥vij.—M.

Sig. Two drops in a tea-spoonful of water three times daily, one hour after meals.

Cod-liver oil, which is required by nearly all cases of rachitis, is useful in relieving constipation, partly, at least, because of its lubricating effect.

In some cases of exaggerated "pot-belly" the abdominal organs being forced forward by the displaced lungs, constipation will persist in spite of all treatment, becoming as it were the normal condition of the child.

Thoracic Complications.—Bronchitis.—More or less tracheobronchial catarrh invariably accompanies rachitis, and in many cases slight exposure to draughts or low temperature excites a severe bronchitis, which may terminate in catarrhal pneumonia and death, or in atelectasis with a like result. For the prevention of bronchitis much may be done by daily cool (from 85° to 90° Fahr.) sponge-bathing, as already advised, followed by friction of the body surface and inunctions of the chest with a small amount of olive oil or vaseline, the oil protecting the skin from sudden changes of temperature. The inunctions must be performed lightly and with care, for if the ribs are much softened harm may be done by strong pressure.

As a rule, depressing expectorants, such as ipecac, and particularly tartar emetic, are contraindicated in rachitis, although in some cases in the early stage of an attack of bronchitis with scanty expectoration, frequent harsh cough, and dyspnœa the wine of ipecac is useful in doses of 5 to 10 drops repeated hourly until the skin becomes cool and moist and the cough less violent. Opium and its derivatives, if used at all, must be given in small doses and with extreme caution.

Syrup of lactucarium is a remedy of great value when it is necessary to obtain rest from a violent distressing cough. From 10 to 20 drops of the officinal syrup may be given every two hours to a child of one year.

Inhalations of steam containing the vapor of compound tincture of benzoin will generally relieve an excessively tight cough, and they are often rendered more efficient by the addition of a small amount of car-

bolic acid. One drachm of the compound tincture of benzoin, 1 minim of carbolic acid, and 6 ounces of water may be placed in an ordinary teapot and brought to a boil over an alcohol lamp, the vapor being conducted to the patient's face by a tube of stiff paper. Or any of the numerous vaporizers, such as Oliver's, may be used for the same purpose, a smaller portion of the benzoin and carbolic acid being then employed. The inhalations should be repeated at intervals of from one to three hours, each inhalation lasting about five minutes. Cloths wrung from hot water and applied to the chest will frequently relieve the dyspnœa, and their efficacy may be increased by sprinkling a few drops of turpentine over the surface or by adding mustard to the hot water from which they are wrung, in the proportion of half a teaspoonful to the pint. In mild cases a mixture of equal parts of oil of amber and olive oil, thoroughly rubbed into the skin of the chest, seem to have an almost specific effect in relieving the cough.

After secretion is established inhalations and all depressing remedies must be discarded for stimulating expectorants and general stimulants, which will be much more urgently required than in bronchitis in a non-rachitic child. Carbonate of ammonium, strychnine, whiskey or brandy, digitalis, and strophanthus, in the order named, are the drugs which will then be most useful.

Nervous Complications.—GENERAL CONVULSIONS.—Rachitis is one of the strongest and most frequent predisposing causes of general convulsions in infancy, and indigestion and constipation are probably the most frequent exciting causes. To prevent their occurrence the most scrupulous attention to diet is necessary, of which sufficient has already been said. The treatment of an attack does not differ from the treatment of general convulsions in children from any cause. The time-honored custom of placing the child in a warm bath is of doubtful expediency, but unless the water is too warm it probably does no harm. The temperature of the water should not exceed 96° Fahr. A hot bath, as pointed out by Dr. Lewis,[1] may be injurious if the convulsion is caused by indigestion, the withdrawal of blood from the stomach and intestine still further interfering with digestion. A warm foot-bath, or, better, wrapping the legs and feet in cloths wrung from mustard-water at a temperature of 105° Fahr., is more efficient than immersion, and much less likely to be followed by chilling of the surface and the consequent congestion of the abdominal and thoracic organs. If it is certain that the child has recently taken improper food, an emetic should be given as soon as it has recovered sufficiently to swallow. For this purpose nothing is better than a mixture of equal parts of alum and syrup of ipecac, of which a small tea-spoonful will usually be sufficient. If there is constipation an enema of

[1] Keating's *Cyclopœdia of the Diseases of Children*, vol. iv.

warm water should be given. While indiscriminate gum-lancing in infants is to be deprecated, it is certain that in rachitis the irritation of an advancing tooth may be the exciting cause of convulsions; and although there is no pressure of the tooth against the tissues, lancing the gum will sometimes be followed by cessation of the convulsions. How the incision acts is not certain, but most probably by relieving congestion through the local depletion. The possibility of the convulsions being excited by acute inflammation of the middle ear, to which rachitic children are predisposed, should not be forgotten.

In many cases by the time the foregoing measures have been carried out the convulsion will have ceased, and further treatment should consist merely in keeping the child quiet in a moderately darkened room and withholding food for a few hours. In severe cases, however, and those in which convulsions occur after brief intervals of relaxation, cerebro-spinal sedatives must be given. Of these the most valuable are chloral and the bromides. A child of one year may take by the mouth 2 grains of chloral with 4 grains of potassium bromide. If this is not sufficient to produce relaxation, it is better to give the subsequent doses by the rectum, increasing the amount of each drug about two-thirds, and repeating them at intervals of half an hour.

In very severe cases the cautious inhalation of chloroform is by far the most efficient and rapidly-acting method of treatment that we possess: the object being only to produce relaxation, and not anæsthesia, not more than 10 drops at a time should be poured upon a handkerchief and held close to the patient's mouth and nostrils. When the spasm relaxes the chloroform is to be withdrawn, but may be resorted to in this amount as frequently as the spasms recur. Nitrite of amyl has been used to a limited extent for the same purpose, but from the reports of cases it seems frequently to fail, and it has no advantages over chloroform.

Opium and its alkaloids are not required in convulsions in rachitic children unless pain, such as earache, is the exciting cause of the attack, in which case codeine in doses of $\frac{1}{30}$ to $\frac{1}{20}$ grain, *pro re nata*, is the best preparation to use.

Laryngismus Stridulus.—Whether we believe with Jacobi that laryngismus stridulus occurring during the first nine months of infancy is invariably due to craniotabes, or with Mackenzie that the glottic spasm of rachitis is caused simply by the general malnutrition, we must admit that the symptom is a not infrequent complication of rachitis, and one which the attendants of the infant should be carefully instructed how to treat, for there is no time to be wasted in summoning a physician. There are a sufficient number of cases recorded in which laryngismus could be produced at will by pressure on craniotabetic areas to warn us that pressure upon the head of a rachitic child must be avoided as far as possible. In cases in which sweating of the

scalp is not excessive the head should rest upon a moderately soft feather pillow, the child's position being frequently changed and the pillow turned over. In most instances, however, a feather pillow causes such free sweating of the head that a soft hair pillow must be used, when it is still more important to change the child's position frequently, in order that continuous pressure will not be made upon one spot.

Open air seems to have a marked effect in preventing laryngismus. J. Lewis Smith reports a case of recurring attacks of laryngismus in which during the spasms there was lividity of the face and sometimes tonic convulsions of the limbs, much more benefit resulting from keeping the infant a large part of the time in the open air than from any other treatment. Robertson advises that children suffering from laryngismus be kept in the open air for many hours a day, even in cold weather and when strong winds are prevalent, provided the air is dry. The open-air treatment is certainly a valuable one, chiefly because of its effect on nutrition, and because it hastens the cure of the rachitis upon which the glottic spasm depends; but it must be carried out with extreme caution, for rachitic infants are remarkably sensitive to the effects of exposure. A daily cool sponge-bath (80° to 85° Fahr.) will often reduce the frequency of the attacks, but here too caution is necessary, lest the child does not react properly and bronchitis be excited. The surface must be thoroughly dried, and briskly but lightly rubbed with the hand until the skin is reddened. Baths of salt solution are frequently employed, but there is little reason to think that their effects are very different from those of plain water baths; moreover, unless the skin is thoroughly freed from the salt, the surface of the body remains damp and perspiration is interfered with. Bromides should not be used for the prevention of laryngismus except in severe cases, as they are depressing remedies, and in rachitis the patient is already depressed and ill-nourished. If the bromides seem to be required by the severity of the case, the ammonium salt may be used in full doses—3 to 8 grains three times daily—for a few days.

Practically, the general treatment of recurring laryngismus consists in the treatment of the disease, on which it depends. In many cases of moderate severity nocturnal attacks may be prevented by giving at bedtime from 20 to 30 drops of syrup of lactucarium, a drug which is not used with sufficient frequency in the respiratory and nervous disorders of infancy and childhood.

Glottic spasm comes on so suddenly that a child who is predisposed to it should be constantly under the observation of two intelligent attendants—one for the day and the other for the night, the time at which the spasms are most common. At the onset of an attack—which may be known by the crowing inspiration, with a general appearance of distress, and perhaps staring eyes, dilated nostrils, and

absolute cessation of respiration, with cyanosis—the child should be immediately carried to an open window, through which a draught is entering, and raised to a sitting posture with the head slightly inclined forward, vigorously slapped upon the back, and cold water sprinkled upon the face. Tickling the nostrils or throat with a feather is frequently advised, but on theoretical grounds it would seem likely to excite reflex spasm, and is not to be commended. In the majority of cases these simple measures soon cause relaxation of the spasm, the child filling its lungs with air and sinking into a quiet sleep, from which it may or may not be aroused by a recurrence of the trouble. In a few cases, however, the crowing inspiration continues, or perhaps the spasm becomes complete and involves all the respiratory muscles, the child rapidly becoming asphyxiated and cyanotic. In such cases sudden and brief immersion in a hot bath—100° to 105° Fahr.—will often be sufficient to relax the spasm, and will be followed by a deep, free inspiration. Ice wrapped in a cloth and applied to the epigastrium was successful in relieving the paroxysms in a severe case reported by the late Dr. C. D. Meigs, and this measure would doubtless be much more efficient if applied while the patient was in the hot bath or immediately after. Cloths wrung from hot water and applied to the throat have also been recommended. In some cases the irritating vapors of ammonia-water held beneath the nostrils will give relief. As in general convulsions, chloroform by inhalation is the most rapidly-acting remedy, and if the nurse has sufficient intelligence she may be provided with a small amount of chloroform and instructed how to use it if the laryngismus is severe or prolonged. Not more than 20 drops may be poured upon a handkerchief held close to, but not in contact with, the patient's mouth and nostrils. In severe cases nothing can be given by the mouth, but in mild cases, in which the stridor is prolonged, relief will soon follow the administration of an emetic, such as a tea-spoonful of syrup of ipecac and powdered alum. The necessity for performing tracheotomy in laryngismus stridulus may arise, and the operation should be performed without hesitation in severe cases in which other remedies have failed.

It may not be out of place here to remind the reader that laryngismus stridulus has no relationship whatsoever to spasmodic laryngitis—that there is no lesion in the larynx, and hence no local treatment is indicated. Laryngitis with glottic spasm may occur in a rickety child, but is unconnected with the constitutional disease, and is discussed by Dr. Sajous under Diseases of the Larynx in another volume of this System.

Tetany.—The prolonged tonic spasms of the muscles of the limbs known as *tetany* may be caused by other conditions than rachitis, but in many cases at least they are a complication of this disease, and require brief consideration here.

Apart from the general measures for the treatment of rachitis already discussed, no special precautions for the prevention of tetany can be adopted. Constipation, diarrhœa, teething, exposure to cold, and any intercurrent disease, such as bronchitis, pneumonia, and acute rheumatism, seem to be exciting causes of tetany during the course of rachitis, and all these should be either guarded against or treated promptly. After the development of tetany, if possible more careful attention to the diet and hygiene than previously shown should be instituted, and no case can be expected to recover so long as diarrhœa, dyspepsia, or constipation continues. Of drugs, the bromides are the most useful, but they are contraindicated by the general depression usually present in rachitis, and by the easily-disordered state of the gastro-intestinal mucous membrane, and hence must be used with great care. A child of one year may be given from 6 to 9 grains daily for a week, provided no untoward effects are produced. At the end of that time it should be withheld for a few days, when it may be given for another week, continuing thus until the spasms relax. In severe cases larger doses may be given for a few days, or a small dose of chloral may be given once or twice daily. Chloroform by inhalation may be resorted to as a temporary expedient during exacerbations of the spasms. A case of Vineberg's, reported by J. Lewis Smith, entirely recovered in one week after $\frac{1}{4}$ grain zinc sulphate and $\frac{1}{192}$ grain atropine sulphate, three times daily, had been prescribed, the patient being fifteen months old.

As both the symptomatology and morbid anatomy suggest that hyperæmia of the spinal cord is the cause of the spasms of tetany, the administration of ergot would seem to be rational treatment, but, so far as I am aware, it has not been used in this disease. Gastric catarrh would of course contraindicate this drug, but in cases in which digestive disturbances are slight or absent it would be well worth a trial, beginning with 2 or 3 drops of a good fluid extract, and increasing the dose until the limit of tolerance is reached.

Physostigma is another remedy which on theoretical grounds should relieve the excitation of the spinal cord, and hence cause relaxation of the spasm. Physostigmine (eserine) could be safely given in doses of $\frac{1}{100}$ grain every six hours, and gradually increased to $\frac{1}{50}$ or even $\frac{1}{40}$ grain, provided no unfavorable symptoms of its action developed, such as prostration, irregular pulse, and contracted pupil.

Osseous System—CRANIOTABES.—Craniotabes, the areas of softening in the cranial bones, is strictly not a complication of rachitis, but rather one of its most frequent, and often earliest, symptoms. The condition can only be prevented by preventing the general disease of which it forms a part. As mentioned in the paragraphs upon laryngismus stridulus, care must be taken that undue pressure is not made

upon the skull in which these softened areas are found. The child's pillow must be soft, but not so soft that the head sinks into it and thereby becomes unduly heated. A lightly-stuffed hair pillow is the best in summer; in winter a moderately firm feather pillow may be used. While sleeping the child's position should be changed every hour or two, so that the same part of the cranium is not pressed upon continuously. According to Jacobi, the value of phosphorus in the treatment of rachitis is especially evident in the rapidity of its effects upon craniotabes. "A very few weeks suffice to change the condition of the cranial bones considerably; the softened parts become smaller and harder, and the consecutive symptoms milder."

"PIGEON-BREAST."—Little can be done to prevent the sinking in of the sides of the thorax and projection of the sternum, known as "pigeon-breast." The deformity is due to the pressure of the atmosphere upon the softened ribs—sucking in of the thorax, as it were—and is aggravated by any cause which interferes with the free entrance of air to the lungs. Hence the necessity for the prevention of laryngismus stridulus and bronchitis, and for their prompt treatment should they arise. The nose, naso-pharynx, and pharynx will require attention should there be obstruction from hypertrophic catarrh, vegetations in the vault of the pharynx, or enlarged tonsils, any one of which conditions will produce the characteristic deformity if the ribs are softened by rachitis. After the termination of the rachitic process much may be done to overcome pigeon-breast by the use of calisthenics, chest-weights, dumb-bells, and other light gymnastic exercises.

SPINAL CURVATURES may be prevented by not permitting the child to assume the sitting posture unsupported until some time after recovery from the disease. Indeed, in a severe case of rachitis the patient should seldom be even held in the arms, but carried upon a firm, large hair pillow after the manner of German nurse-maids.

DEFORMITIES OF THE LONG BONES.—Curvatures of the legs and thighs, knock-knee, and flat-foot are to be avoided by not allowing the child to stand until the shafts and epiphyses have resumed their normal hardness. The mechanical and operative treatment of established rachitic deformities of the long bones does not come within the scope of this article, but it may be said that most orthopædic surgeons discountenance treatment by apparatus while the rachitic process continues.

It is evident from what has been written that the successful treatment of rachitis, as of most diseases, depends more upon the general management of each individual case and the treatment of complications than upon drug-giving; and the physician who is most familiar with the principles of the hygiene of infancy will have the greatest success in the treatment of this disease.

ACUTE AND CHRONIC ARTICULAR RHEUMATISM, RHEUMATOID ARTHRITIS, AND GOUT.

By JAMES STEWART, M. D.

ACUTE ARTICULAR RHEUMATISM.

Our knowledge of the nature of acute rheumatism being still in the hypothetical stage, the treatment is therefore, in the main, of an empirical character. Of the various hypotheses advanced to explain the cause of this disease, that which connects it with the classes of the acute infectious diseases is the one which at the present time receives most favor. Repeated and careful bacteriological investigations will alone determine the truth or falsity of this view.

In the treatment of acute rheumatism it is important to remember that we have to do with various inflammatory affections; we therefore can make use of those means which an accumulated experience has shown to be of value in such states.

Of all measures in the treatment of a local inflammation, rest, next to removing the cause, is the most important. The objects gained in employing rest in acute articular rheumatism are—(1) We directly lessen the inflammatory action in the affected joints; (2) We also lessen the extent and effects of the endocardial inflammation. In severe cases the patient is compelled to remain absolutely quiet, but in the subacute varieties this necessity is not felt by the patient, and it therefore should be the duty of the physician to insist on rest in bed. It is a well-recognized fact that endocarditis occurs as frequently from subacute as from acute attacks. Further, the endocardial inflammation may be the main, or possibly the only gross, change attending the rheumatic state. It is in such cases that the enforcement of rest is likely to be neglected, as the pain in the joints is wanting.

Rest should be enjoined not only during the acute, pyrexial stage, but for some days afterward. The danger of relapse is certainly thus lessened, and if any endocardial inflammation is present, its extent and after-effects are undoubtedly lessened.

The practice of keeping a patient lying between blankets is never necessary, and is not infrequently irksome and distressing, preventing

the complete fulfilment of the first indication, the enforcement of rest. If the sweating is very profuse lying upon a blanket is all that is necessary.

Local Treatment.

Various local means have been at one time or another employed to lessen the inflammatory action and consequent pain. The blistering treatment of Dr. Herbert Davies has few adherents at the present time. It undoubtedly has a marked influence in relieving the pain in the joints, but it not infrequently sets up a hæmorrhagic nephritis and cystitis—outward symptoms of a grave character. Various anodyne substances are in common use—painting the inflamed joints with tincture of iodine or the employment of aconite and chloroform liniments and covering the parts with cotton wool. Dr. H. A. Hare recommends very highly the following application:

℞. Ichthyolis, ʒiv to ℥j;
Adipis, ℥ij.—M.
Sig. Apply about the part affected and rub in well.

The ichthyol does not cause any irritation, and, in addition to relieving the pain, it promotes the absorption of the effusion.

Fuller's lotion is a favorite application with many physicians. It consists of—

℞. Tincturæ opii, f℥j;
Potassii carbonatis, ʒiv;
Glycerini, f℥ij;
Aquæ, f℥ix.

It is applied to the joints by means of lint. This dressing should not be covered with an impermeable covering, as this causes local irritation and distress.

The application of cold, as recommended by Sénator and practised in some of the German clinics, is a measure which has not found imitators in America. It is of doubtful utility.

The application of proper splints to the inflamed joint gives relief in severe cases.

Internal Treatment.

Before the introduction of salicylic acid and agents belonging to the same class the treatment of acute rheumatism was as various as it was unsatisfactory. A very short time previously to this a great number of the profession were of the opinion that we had no medicinal agents of any value in this disease. The simple rest treatment of Sir William

Gull and Dr. Sutton had greatly disturbed the medical mind, the result being that many went from one extreme to the other. As will be shown later, these extreme views were incorrect, for there is a certain class of cases in which some of the agents used in the pre-salicylic-acid days are very useful.

Salicylic Acid.—Salicylic acid was first employed in the treatment of acute rheumatism in 1875 by Buss of Basle, but the remedy did not attract wide attention until the observations of its action in Traube's clinic were made known in the following year by Stricker. During the same year Maclagan, then of Dundee, published the results of his observations on the use of salicin. He was led to employ salicin from a belief in the miasmatic nature of rheumatism.

The salicylic-acid treatment will be considered under the following heads:

I. Its influence over the symptoms of the disease, and especially its effects on the joint-pain and pyrexia.

II. Its influence in preventing and ameliorating the cardiac complications and the hyperpyrexia.

III. Its influence in preventing relapses and on the duration of the disease.

IV. The untoward effects of salicylic acid.

V. Mode of action.

VI. Dose and mode of administration.

The Influence of Salicylic Acid on the Pain and Other Symptoms of the Joint Inflammation.—Among the first noticeable effects of salicylic acid is the subsidence of the pain and swelling in the joints. Usually, after three or four doses, there is distinct relief, and in the great majority of cases complete relief between the third and fifth days.

The report of the Collective Investigation Committee of the British Medical Association, which is based on 655 cases, shows 10.18 days as the average duration of pain. In a collection of about 500 cases treated in various London hospitals (St. George's, London, Middlesex, and Westminster) the average duration of pain barely exceeded five days. A probable explanation of this difference is that the hospital cases were treated more actively than the cases collected from such various sources as those of the Collective Investigation Committee. There can be no question that salicylic acid is much more powerful in giving relief than any previously employed antirheumatic drug, and in my experience it is very exceptional to meet with a case in which the acid fails to give considerable relief.

The Influence of Salicylic Acid on the Pyrexia.—Coincident with the relief of the articular symptoms we almost invariably have a marked fall in the pyrexia of the disease. At times the fever is lowered before distinct relief from pain is experienced by the

patient. In 190 cases of acute and subacute rheumatism collected by Warner the average duration of pyrexia under salicylate treatment was 5.5 days; in 156 cases collected by Owen from the records of St. George's Hospital, London, the average duration of pyrexia was 3.66 days; in 86 cases treated at the Middlesex Hospital (London) Coupland says the average duration of the pyrexia was 5 days; 55 cases from the Westminster Hospital shows an average of 7.25 days.[1]

The foregoing statistics include the total duration of the pyrexia. Practically, in the great majority of cases the temperature is reduced to near the limit of pyrexia in from one to two days.

The Influence of Salicylic Acid in Preventing the Cardiac Manifestations of the Rheumatic Poison.—The most important indication to be fulfilled in the treatment of acute rheumatism is to protect the heart. There is sufficient evidence to prove that the salicylates fail to do this efficiently. That they have a very important indirect influence, through diminishing the total number of days that the patient is exposed to the danger of cardiac involvement, is undoubted. The direct influence is, however, slight. This is not only true of the prevention of cardiac complications, but also of the action of the acid in arresting such when once they have set in. The following evidence is adduced in support of the above view: Dr. Hood[2] read a paper before the Medical Society of London based on observations obtained from the treatment of 2200 cases of acute sthenic rheumatism occurring in both sexes under thirty-six years of age. Of these cases, 850 were treated in Guy's Hospital before the introduction into practice of salicylates; the remaining cases were treated with the salicylates in Guy's and St. Bartholomew's hospitals. Out of the 850 cases treated in various ways, but without salicylates, it was found that 500 had cardiac disease. "Examining the salicylate cases in series as they were collected, of 328 cases from Guy's 190 were affected. In a second series, from Guy's, of 360 cases, 241 had cardiac complication; and again in 515, from St. Bartholomew's, 316 were affected." In the cases treated by the salicylates it was found that in the aggregate slightly over 60 per cent. were affected, while in those cases treated by various other methods slightly under 60 per cent. were affected. As Dr. Hood points out, these percentages practically agree, and show that the salicylates are no more effective in preventing cardiac mischief than is any indifferent treatment. The percentage of cardiac disease in the cases treated by salicylates does not differ from the usual proportion of cases of cardiac disease, it being generally admitted that from 50 to 60 per cent. of all cases are attended by this complication.

[1] R. P. Howard in Pepper's *System of Medicine*, vol. ii. p. 52.
[2] *Lancet*, April 14, 1888.

Influence of the Salicylates in the Prevention of Hyperpyrexia.—There seems to be a general impression, since the introduction of the salicylates into practice, that fewer cases of hyperpyrexia have been reported than formerly, and that therefore these agents have an influence in preventing this grave complication. That they are not entirely effective is shown, however, by the report of a number of cases in which hyperpyrexia set in while the patient showed effects of full doses (cinchonism). After hyperpyrexia has set in, the salicylates have no control over it.

The Influence of the Salicylates in Preventing Relapses.—Relapses are considered to be more frequent after the salicylates than after the alkaline treatment. They occur in a number of cases in which the treatment is continued even after the subsidence of the pain and pyrexia. They are especially frequent in the cases in which the treatment has been discontinued after the cessation of the articular symptoms and pyrexia. In his article on acute rheumatism in Pepper's *System of Medicine*, Dr. Palmer Howard, in speaking of the liability to relapses under the salicylate treatment, says: "The short intervals which frequently obtain between the primary invasion of the so-called relapses, and the failure of the salicyl compounds to prevent peri- and endocarditis, render it probable that what are commonly spoken of as relapses are not due to a new infection, as in the case of the relapse of typhoid fever, but to the recrudescences of a disease not yet terminated, but over some of the manifestations of which—the articular inflammation and the pyrexia—the salicylates exercise some control."

To account for the relapses Dr. A. E. Garrod throws out the suggestion that the salicylates have a marked influence over the hyperæmic group of symptoms (arthritis and pericarditis), while they have no influence over the fibrous group (the endocarditis).

That salicylic acid has a marked effect in diminishing the total duration of acute rheumatism seems to be proven, but in the cases in which cardiac complications arise the time during which it is necessary for the patient to remain in bed is not lessened, as compared with the alkaline and other older methods of treatment.

The Untoward Effects of Salicylic Acid.—Unfortunately, it is not uncommon to meet with cases in which the salicylic acid induces disagreeable, and at times grave, symptoms, necessitating its withdrawal. Among the minor untoward effects we would mention the symptoms of cinchonism—ringing in the ears, deafness, and dimness of vision. These symptoms almost invariably set in when full doses are given, and rarely are of sufficient importance to interfere with the continuance of the treatment.

Certain other nervous symptoms are of a graver nature. Salicylate delirium is not an infrequent symptom. It occurred 32 times in 174

cases treated in Guy's Hospital between the years 1881 and 1886.[1] It is much more apt to occur in inebriates and those of a neurotic temperament. The character of the delirium varies. Some cases are violent, others are cheerful and talkative, while in others the type is melancholic. Thus we have all degrees of delirium, from talking during sleep up to furious mania. In its severer forms it is usually attended by visual and auditory hallucinations. Salicylate delirium may be mistaken for the delirium brought on by hyperpyrexia.

Symptoms of cardiac depression, attributable to the salicylates, have been reported. They occur only from the employment of very large doses.

When we have disease of the kidneys interfering with the elimination of the drug, a sufficient quantity may accumulate in the blood, even from moderate doses, to bring about cardiac failure.

Symptoms of irritation of the kidneys sometimes occur when salicylates are given to rheumatics. Albuminuria and hæmaturia were met with 8 times in the 174 cases referred to above.

Among other symptoms occasionally met with in the salicylate treatment, and probably due to it, may be mentioned epistaxis, retinal hæmorrhages, erythema, urticaria, petechial spots, and intense itching sometimes attended with the above skin eruptions, and sometimes without any visible change in the skin. Finally, it is not rare to find nausea and vomiting. These symptoms occurred 32 times in the 174 cases previously referred to.

Mode of Action of Salicylic Acid in Acute Rheumatism.—In the present state of our knowledge it is impossible to explain satisfactorily the mode of action of salicylic acid in acute rheumatism. Several different hypotheses have been advanced. These are usually founded on what the originator believes is the true nature of the disease. For instance, those who believe in the microbic origin of acute rheumatism attribute the beneficial action of salicylic acid to the destruction of the micro-organisms. Those who believe in the lactic-acid theory of rheumatism claim that the production of this agent is prevented by the administration of salicylic acid. Dr. Haig's hypothesis, recently advanced, is to the effect that the salicylates promote the elimination of uric acid. Others consider that the acid acts by a direct influence on the inflammation in the joints and elsewhere. And, finally, there are those who hold to the neurotic theory, and are forced to explain the beneficial effects by the supposition of an action on the nervous system.

That salicylic acid is not an antidote to the poison of acute rheumatism is clearly proven by statistics. That it sometimes altogether fails to remove or check any of the symptoms of the disease is a well-estab-

[1] Quoted by A. E. Garrod, *Treatise on Rheumatism.*

lished fact. That it has but little if any influence over the cardiac and nervous manifestations of the disease is generally admitted. It must be conceded that the cardiac and nervous disorders of the early stages of acute rheumatism are part and parcel of the disease, and not secondary manifestations. If salicylic acid is an antidote to the cause of the articular changes, it should also be an antidote to the cardiac and nervous troubles which so constantly arise. It is clear, therefore, that salicylic acid does not destroy the micro-organism of acute rheumatism.

Little need be said of the remaining hypotheses referred to. It can with truth be said of all of them that they are not proven and are of an unstable character.

The Dose and Mode of Administration of Salicylic Acid.—There is considerable diversity of opinion as to the particular form in which the salicyl compound is best administered. Some recommend the artificial, others the natural, salicylic acid. A few are of the opinion that salicin is the most efficient. The great majority of practitioners look upon the sodium salt as the best form for administration.

The following method is one which we believe to be worthy of trial: First, to administer the salicylate of sodium for three or four days, or until such time as a decided impression is made on the pyrexia and pain, and then to replace it with salicin, which is to be continued for several days after the disappearance of all symptoms. By adopting this method we obtain, in the first place, the prompt and decided action of the sodium salt, which of all the salicyl compounds is the most prompt and decided in action. Secondly, we are less apt to meet with untoward effects from salicin. We therefore, in a measure, obtain by this method the most desirable action and minimize the untoward effects of the salicyl compounds.

The natural sodium salicylate should be preferred to the artificial product; but it is not true that the former is free from the untoward effects not uncommonly following the administration of the latter. All salicyl compounds are at times followed by untoward effects, but they are less marked and less frequent after the natural preparations. The delirium following the use of salicylic acid has been attributed to impurities.

It is claimed that the dithiosalicylate of sodium (a salt having the composition of two molecules of salicylic acid linked by two atoms of sulphur) is less liable to bring about disagreeable effects than any of the other salicyl preparations. It is freely soluble in water, and can be given in doses of from 3 to 5 grains.

The oil of gaultheria (wintergreen), which contains an impure salicylate of methyl, is highly recommended by Wood, Kinnicutt, Hare, and others. It is claimed that it is as effective as the salicylate of

sodium in acute rheumatism, and that it is less liable to bring about any of the usual disagreeable effects of the latter drug. Reports are, however, contradictory in this respect. That it induces the usual symptoms of cinchonism in ordinary medicinal doses cannot be denied, and, if these, probably also the graver symptoms of delirium and cardiac depression. The usual dose of the oil of gaultheria is from 10 to 20 minims. It is best administered in capsules.

Salol is another salicyl preparation employed to a considerable extent during the last two or three years. This substance, when it reaches the intestines, is split up into its phenyl and salicyl elements. Its value in rheumatism depends on the salicyl element, and experience has shown that it is no more efficient than a corresponding dose of salicylic acid. It is open to the objection that it may cause carboluria. The dose varies from 4 to 30 grains. It can be administered in cachets or in pills.

In the administration of sodium salicylate it is a usual practice to give it in about 15-grain doses every two or three hours until the symptoms of cinchonism set in, and to continue it in doses sufficiently large to keep up these symptoms for several hours longer. Then the quantity is to be gradually reduced, but it is well to continue it for two or three days after the disappearance of the symptoms, provided no marked untoward effects arise. If after a trial of ordinary full dose no relief is obtained, it is unwise to continue its administration. Although it is not necessary to induce the symptoms of cinchonism, as a rule it will be found that in severe cases marked relief is not obtained before these symptoms appear. The practice of discontinuing the sodium salicylate when cardiac complications set in is not, in our opinion, a judicious measure. It is better to combine it with an alkali, it being understood that there is no evidence of cardiac failure present. The following is a good method of giving the sodium salicylate:

℞. Sodii salicylatis, ʒiij;
Syrupi zingiberis, ℥j;
Aquæ, q. s. ad ℥vj.—M.
Sig. A table-spoonful every three hours.

The fluid extract of liquorice may be also used as a vehicle.

Antipyrine, Acetanilide, Phenacetin, and Allied Agents.—All of this group have been used with more or less success in the treatment of acute rheumatism. Some observers claim for them an action more or less specific—an action beyond their antipyretic and analgesic effects. That all quickly reduce the fever and relieve the pain is generally admitted, but as yet we have not sufficient experience to justify

us in admitting any further action. In fact, as already mentioned, we have no positive data to show us that the salicylates are able to do any more than this.

H. A. Hare,[1] while believing that antipyrine quickly relieves the pain, finds it is not so efficacious in diminishing the duration of the disease as acetanilide. He has seen it quickly relieve the pain and reduce the pyrexia in cases where the iodides and the salicylates failed to do so. Speaking of its action in the cases in which relief does not come from the salicylates, he says: "I have found that acetanilide in such cases will often relieve the pain, and so permit a refreshing sleep, in doses of from 4 to 8 grains three times a day, and that these amounts do not cause the excessive sweating which necessarily large doses of salicylate are sure to produce—sweats which leave the patient oftentimes almost dyspnœic from very weakness. Whether this temporary relief produces such changes in the system as to permit of a better battle against the disease, or whether it actually counteracts the rheumatic poison, we know not; but we do know that following its employment the relief is not only temporary, but often permanent, and that a very distinct step in advance is made toward the close of the attack if any influence at all is felt."

Antipyrine being a patented name, it is better prescribed under the name phenazonum (Br. Ph.). It can be given in doses of from 10 to 20 grains every two or three hours until a decided impression is made on both the pyrexia and the pain. It can be readily taken in watery solution or in cachets. Acetanilide (antifebrin), being insoluble, can be prescribed in the form of powder and taken in cachets. Its dose is from 4 to 8 grains. Phenacetin can be prescribed in a similar way, and in doses of from 5 to 15 grains.

Although this group of agents are free from inducing the untoward effects following the salicylates, they have a train of untoward effects peculiar to themselves, the minor ones being certain skin rashes, which are of no special significance, but the ulterior effects sometimes wrought in the blood are of importance. We refer to the conversion of a portion of the hæmoglobin into methæmoglobin. Further, we have at times a distinct cardiac depressant action from them. It follows that in the way of disagreeable, and even dangerous, symptoms there is little to choose between them and the salicylates.

Benzoic acid and the benzoates, a class of agents closely allied to salicylic acid and salicylates, have been highly recommended by Sénator and others in the treatment of acute rheumatism. It is claimed for the sodium benzoate that it does not disorder the stomach or give rise to the other disagreeable effects following the use of the salicylates. It can be prescribed in doses of from 15 to 20 grains every two or three

[1] *Practical Therapeutics*, p. 534.

hours. In spite of the favorable reports of a few competent observers, this agent has not come into general use.

Alkaline Treatment.—Prior to the introduction of the salicylates the treatment of acute rheumatism generally adopted was by the use of alkalies. It was, and is even yet, claimed by many that these agents have a marked influence in directly diminishing the articular inflammation and lessening the duration of the disease. Neither of these assertions has been proven. The statistics of Gull and Sutton show that the natural course of the disease when the patient is kept quiet in bed varies but slightly from the course when alkaline treatment has been faithfully carried out.

The report of the Collective Investigation Committee of the British Medical Association, drawn up by Dr. Whipman, shows as a result of the alkaline treatment in 26 cases a duration of 13.33 days for the fever, 19.0 days for the pain, and a duration of 36.30 days for the whole attack.

When we compare the committee's statistics on the salicylate treatment with the alkaline treatment we find a considerable difference in favor of the former. They report 173 cases treated with the salicylates, with an average duration of 8.65 days for the fever, and in 171 cases the average duration of the pain was 10.18 days. The whole duration of the attack in 167 cases was 19.03 days under the salicylate treatment. It will be seen that relief from pain and pyrexia was much quicker from the salicylate treatment. The difference, however, in the duration of the disease in the two series was not marked.

It is claimed that the alkaline treatment is effective to a certain extent in preventing cardiac complications. This is an important claim, and, if we can credit the statistics on the matter, it is sustained. Dr. R. P. Howard, from a collection of statistics on this point, gives as the average of the setting in of cardiac complications 14 per cent. under the salicylate treatment and 7.8 per cent. under the alkaline treatment, and from this he concludes that "it is not improbable that a combination of sodium salicylate with full doses of bicarbonate of potassium will give better results in the treatment of acute rheumatism than either of these classes of remedies alone. Indeed, Flint and others have advised such combinations, and Bedford Fenwick has recently stated, as a result of his experience in 30 cases, that if, after giving a free purge, followed by 20-grain doses of sodium salicylate hourly for six hours, that salt be stopped, and in twelve hours afterward half-drachm doses of the citrate of potassium be administered every four or six hours until the saliva becomes alkaline, relapses will be extremely rare, and that this is the safest and most successful method of treating acute and subacute articular rheumatism."

A great number of other drugs have been used in the treatment of

acute rheumatism. It would serve no useful purpose to do more than mention some of these. Iodide of potassium, quinine, trimethylamine, cimicifuga, rhus toxicodendron, guaiacum, colchicum, aconite, iron, and different mercurial preparations have all been employed, but at the present time they are generally considered to belong to the dead past.

The Diet in Acute Rheumatism.—In the early stages of acute rheumatism the diet should be of a non-nitrogenous character: milk, oatmeal gruel, and barley-water are suitable. While the pyrexia is present it is well to avoid nitrogenous food, and meat should not be taken too early in convalescence, for there is evidence showing that its too early use may bring about a relapse.

In uncomplicated cases of acute articular rheumatism stimulants are, as a rule, injurious. Anæmic individuals, especially if the course of the disease is somewhat prolonged, may be benefited by stimulants. When visceral complications are present, the indication for the employment of stimulants is the same as in any acute or subacute febrile disease.

Treatment of the Visceral Complications of Acute Rheumatism.

It is my intention to give only a sketch of the general measures to be employed in the beginning stages of these internal manifestations of the rheumatic poison.

Pericarditis.—When pericarditis sets in, what is to be done? Is it necessary to adopt any special internal treatment, or are the salicylates or a combination of salicylates and alkalies the best means of treatment at our command? We believe that the combined treatment last named, if not already employed, should be used. The application of a blister to the præcardiac region is a common practice. It is difficult to prove or disprove its efficacy. If the pain is severe, morphine should be employed, preferably hypodermically.

The treatment of the products of the inflammatory action will be found under the head of the special article dealing with the treatment of pericarditis.

Endocarditis.—If the alkalies have not been previously used, they should at once be combined with the salicylates, or if thought advisable they may be given alone. It has already been shown that of all forms of treatment they are probably the most effective in preventing endocardial inflammation, and if so we have no good reason to doubt that they may limit an inflammation which has already begun. Of all measures for the limitation of the endocardial inflammation, most stress should be laid on the enforcement of rest in bed with a dry diet. Both of these means act by lowering the blood-pressure, and the lower this is kept the less work the heart has to do, and in consequence the inflam-

matory process is less likely to extend. The daily administration of two or three 10-grain doses of chloral will, according to Balfour, greatly assist in limiting the inflammatory action.

The treatment of the pleurisy and pneumonia attending acute rheumatism does not call for special attention in the present article.

Hyperpyrexia.—Of all the complications of acute rheumatism, hyperpyrexia is the most formidable. Since the introduction into practice of the salicylates cases of hyperpyrexia have been rare, but it is very doubtful whether this treatment has had any direct influence in preventing hyperpyrexia, for numbers of cases have been reported where it has set in during the period that the patient was taking these agents in full doses.

Of the cases collected by the Committee of the Clinical Society of London[1] in the year 1882, it was found that about 80 per cent. occurred during the years 1873–77. The strange and unexplained variation in the proportion of cases of hyperpyrexia at different periods is well illustrated by the fact referred to by Dr. A. E. Garrod, that during a period of six years (1881–86) only a single case of hyperpyrexia occurred in St. Bartholomew's Hospital.

The onset of hyperpyrexia may be sudden or it may be preceded by delirium and the other nervous symptoms constituting the symptom-complex of cerebral rheumatism.

When hyperpyrexia has set in, it is useless to employ drugs of any kind to reduce it. It is only wasting valuable time. The only measure of real value is cold, and it is clear from the general experience on this point that the sooner it is employed the better are the patient's prospects for recovery.

The Committee of the Clinical Society in their report consider that the temperature cannot safely be allowed to rise above 105° F. They found that among the untreated cases several had proved fatal in which a temperature of 106° had been reached. It therefore can be concluded that when the temperature suddenly rises from a moderate degree to 105°, cold should be employed.

The general cold bath is certainly the most effectual way of carrying out the antipyretic action of cold. In hospital practice there is no difficulty in doing this, but not infrequently in private practice, on account of the antagonism of the patient's friends and the inadequacy of the means, it is oftentimes impossible.

As a rule, it is better to place the patient in a bath at a temperature of 90°, and gradually cool it down to 65°, or even 60°. The patient should not be kept longer in the bath than the time it takes to reduce his temperature to 101° or 100°. As the temperature continues falling for some minutes after the removal from the bath, it is important not

[1] *Clinical Society's Transactions*, vol. xv.

to have it lower than 100°. When the patient is removed from the bath he should be rapidly dried and wrapped in blankets, and a stimulant may be necessary.

It is impossible to predict in any case what time will be required to bring about the necessary reduction. It is seldom found necessary to keep the patient in the bath longer than an hour. In the majority of cases from one-half to three-quarters of an hour is not exceeded. If the reduction is not effected in an hour, there is no reason why the patient should not be kept in longer, as the measure is the only one that gives us any hope of doing good. In some instances a single bath is all that is necessary. If the temperature should, however, re-ascend, a second bath should be given. There is hardly a limit to the number that may be employed. In the Clinical Society's report there is mention made of two cases that ultimately recovered in which twenty-six baths were found necessary.

Practically speaking, there is no complication that forbids or contraindicates the employment of cold baths. The condition of hyperpyrexia is so grave that it completely overshadows all possible minor dangers following as the result of the use of cold.

Of the cases reported on by the Clinical Society's committee, only one case recovered with a temperature higher than 106° F. in which the bath was not employed. Of the bathed cases with a temperature of over 106°, nearly 60 per cent. recovered. Several cases are on record where recovery has followed the use of cold in which the temperature reached 110°.

The evidence in favor of the value of cold bathing in hyperpyrexia is conclusive. Often it is not effective, but we certainly have no means to compare with it. It not only reduces the temperature, but also quiets the delirium. If the patient has been previously comatose, the mind becomes clear, the pulse is reduced in frequency and increased in strength, and normal sleep returns to relieve the nervous system.

When from various reasons the general cold bath cannot be used, we may obtain reduction of temperature by using cold in various other ways. Sponging the body with ice-cold water or the cold wet sheet-pack may be made use of. In the country, especially during the summer months, the latter is the only available method.

Professor H. C. Wood[1] recommends what we believe is an admirable method of carrying out this treatment in those cases in which it is not possible to make use of the general cold bath. Referring to the employment of cold in general febrile disorders, especially in typhoid, he says: "When no portable bath-tub is at hand, antipyresis may be had by lifting the patient, wrapped in a sheet, upon a cot covered with a rubber blanket, and sousing rather than sponging him with cold water

[1] *Therapeutics, its Principles and Practice*, p. 71.

from a large carriage-sponge. If the sacking-bottom or canvas of the cot be so loose as to sag down several inches, and the rubber blanket be turned up at the bottom and top over a wide board nailed across the top and bottom, the patient during the sponging lies in a big pool of water, and all the effect of the cold bath is obtained by removing with a carriage-sponge this water as fast as heated, and sousing fresh cold water (ice-water if necessary) freely over the upper part of the patient."

CHRONIC ARTICULAR RHEUMATISM.

THE treatment of chronic articular rheumatism is mainly a preventive treatment. There is, strictly speaking, no curative treatment for this disease.

HYGIENIC TREATMENT.

A dry, warm, and uniform climate is the most suitable for chronic rheumatics, but only a very few can avail themselves of the benefit to be obtained from climatic changes. The disease is mainly met with in the poor laborers or cabmen of cities and among the farmers in the country—classes which are unable to make any change.

The chronic rheumatic should live in a dry and warm dwelling. He should wear flannel next the skin. Attention to these general measures constitute the hygienic treatment of the disease. They act by preventing the action of the well-known exciting causes of the disease. It is of importance also to attend to the general constitutional state. If this is in a depressed condition, the administration of cod-liver oil, arsenic, and iron is called for. Through these means we increase the resisting powers of the tissues, and therefore lessen the tendency of the articular tissue to take on inflammatory action. The direct treatment of the disease includes general and local measures.

GENERAL MEASURES.

Unfortunately, we have no measures of any value. Salicylates, alkalies, and quinine are in the great majority of cases of little or no value. At times we meet with cases where the salicylates appear to give a degree of relief, but it is questionable whether they have any direct influence. No doubt during the course of chronic rheumatism we meet with regular superadded subacute inflammatory attacks, and in such cases relief would be expected from the salicylates; but whether these agents have any direct influence over the cause or causes which underlie chronic rheumatism remains to be proven.

A number of observers speak very favorably of the action of ich-

thyol in chronic articular rheumatism. It can be administered in the form of the sulpho-ichthyolate of sodium or lithium, in doses of from 10 to 30 grains. Owing to its disagreeable tarry odor it should be given in capsules.

For the local treatment of the articular affection in chronic rheumatism an ointment of the sulpho-ichthyolate of zinc or a plaster of the sulpho-ichthyolate of lithium is probably more efficient than anything else.

On the Use of Mineral Baths in the Treatment of Chronic Rheumatism.—From time immemorial mineral baths have been a favorite method of treating chronic articular rheumatism. The warm sulphur and alkaline baths are those most prized.

In employing warm sulphur baths it is doubtful whether the quantity of sulphur is sufficient to exert any special local or general action. In all probability the main benefit is derived from the heat. The more important warm sulphur baths on this continent are those at Banff in Alberta, Canada. The temperature of the thermal springs varies from 93° Fahr. to 127° Fahr. At this resort there is to be found all the comforts and conveniences met with in the best-conducted European health-resorts.

The Arkansas thermal springs have also a well-deserved reputation in cases of chronic rheumatism. In Virginia and California there are numerous thermal springs, all having at least local reputations for the relief of chronic rheumatism.

Before deciding to send a patient to make use of thermal waters a careful examination should be made of the kidneys and circulation. Organic disease of the kidneys, when complicated with degenerative changes in the arteries or hypertrophy of the left ventricle, contraindicates the use of hot baths. Simple hypertrophy of the left ventricle, with good compensation and no affection of the vessels or kidneys, does not necessarily contraindicate hot baths. Very old patients, as a rule, whether there is any internal organic disease or not, should avoid the use of hot baths.

On the European continent the more important hot sulphur baths are those at Aix-les-Bains in Savoy. The temperature of the water varies from 112° to 114°. In Rhenish Prussia there are the important baths at Aachen (Aix-la-Chapelle), the temperature of the water being from 97° to 110°.

The following is, according to Brandis,[1] the usual method of dealing with cases of chronic articular rheumatism at Aix-la-Chapelle: From three to four glasses of the thermal water are drunk during the course of an hour. In the intervals the patient is recommended to take gentle exercise. An hour after breakfast a bath is taken, and

[1] *Aachen als Kurart*, S. 101.

when all tenderness has disappeared the joints are douched with water at the same temperature as the bath, and at the same time they are gently rubbed for about fifteen or twenty minutes. Whether the patient takes rest or exercise after his bath depends on his general state and the condition of the weather.

The thermal waters of Bath in England have a well-deserved reputation in chronic rheumatism. The temperature of these waters varies from 104° to 120° Fahr.

RHEUMATOID ARTHRITIS.

Within a comparatively recent period the views of the value of treatment in checking the progress of the articular affection in rheumatoid arthritis have been considerably modified. It was formerly believed that treatment was of little or no avail in preventing the steady progress of the lesions characteristic of this affection. We now know, however, that if rheumatoid arthritis is recognized early and properly managed, it may not only be arrested, but practically cured. If the joint-changes have been marked, we cannot expect to influence them to any extent.

Rheumatoid arthritis is now recognized to be a disease essentially dependent on agencies which tend to lower the general constitutional state, and as such calls for the use of measures the reverse of those we employ in acute rheumatism and gout.

The treatment of this disease with measures of a debilitating character is accountable for the absolutely unfavorable prognosis usually entertained by authorities in the past. Before dealing with the treatment proper it will be well to glance at the more important causes of this disease. This is done with the intention of pointing out the great rôle played by debilitating agencies in bringing about rheumatoid arthritis.

In carrying out the treatment of this disease it is essential that a most careful scrutiny be made into the patient's past history. The first important fact in this connection is the period of life during which the trouble usually comes on. It is mainly a disease of the early period of degenerative life. Its much greater frequency in females is to be attributed to the usual depressed health of women at the climacteric period. It has been pointed out by various observers that frequently uterine or ovarian disease is present. The causation is probably, in the great majority of cases, an indirect one, the uterine disease by bringing about a lowered state of health predisposing to the rheumatoid arthritis.

Anything that lowers the general tone of the nervous system is a potent factor in the causation of many cases of rheumatoid arthritis. Prolonged mental anxiety, traumatism, etc. act in this way. Cases are on record in which a sudden severe mental shock has been the essential cause in lowering the vitality. The influence of cold and damp is of importance also, but probably indirectly through lowering the resisting power of the tissues.

In the treatment of rheumatoid arthritis the first step is to endeavor to combat, when possible, the cause or causes at work in inducing debility. Secondly, our great aim should be to increase the resistive power of the organism.

Sometimes much can be accomplished toward the fulfilment of the first indication, sometimes very little. If there is present any disease which we know tends to debility, an endeavor should be made to remove it. It is important that any uterine or ovarian disease present should receive attention. As to the fulfilment of the second indication, increasing the resistive power of the tissues, we have several agents of proved value.

Cod-liver oil deservedly holds a high place. It should be taken for long periods. A good custom for patients presenting any symptoms of rheumatoid arthritis is to take cod-liver oil during the winter months for several years in succession. In the administration of cod-liver oil it is important to remember that its digestion takes place in the small intestines. It therefore should be given some time after meals, from one and a half to three hours, at the period when the food begins to pass into the small intestines.

Arsenic, next to cod-liver oil, is the most useful agent in the treatment of rheumatoid arthritis. The well-known hæmatinic action of this agent is probably the chief factor in its usefulness. Arsenic is only of use in the earlier stages of the disease. As pointed out by Charcot,[1] Howard,[2] and others, arsenic often proves injurious in advanced severe cases. It often revives pains that have been long dormant, and not unfrequently gives rise to redness and swelling. If the drug is continued in small doses, these acute symptoms soon subside, but it is to us a matter of grave doubt whether in severe cases this agent should ever be employed. The arsenic can be given in the form of Fowler's solution in doses of from 2 to 5 minims, well diluted after each meal. The liquor sodii arseniatis is another preparation. It can be given in doses of from 5 to 10 minims three times daily. Gueneau de Mussy and Bean recommend arsenic in the form of arsenical baths. These baths are used at a temperature of from 90° to 97° Fahr. It has been shown by Charcot that arsenic, when used in the form of baths, is not absorbed by the unbroken skin. He found that when cases

[1] *Lectures on Senile Diseases*, p. 222. [2] Pepper's *System of Medicine*, p. 98.

were treated with arsenic given internally the drug soon appeared in the urine, while when it was employed in the form of baths it was never detected in the urine. It appears to be clear from these investigations that whatever virtue arsenical baths possess in rheumatoid arthritis they owe to their thermal qualities, and not to the arsenic.

Iron is of considerable value in certain cases of rheumatoid arthritis. It is indicated in those cases in which anæmia is present.

The three drugs dealt with—viz. cod-liver oil, arsenic, and iron—are the more important medicinal agents used to increase the resistive power of the tissues to the disease. As fulfilling the same indications, it will now be appropriate to consider the hygienic and dietetic treatment of rheumatoid arthritis.

Dietetic Treatment.—It is important that the diet should be of a nourishing and mixed character. The practice of limiting the amount of nitrogenous food is not to be commended. Provided that there is no general or local contraindication, the patient should be directed to take as much nitrogenous food as can be digested with facility. Should there be any functional derangement of the digestive organs, it must be corrected. Stimulants may be allowed, but it is necessary to lay down strict rules as to the quantity. This should not exceed the quantity necessary to stimulate the secretion of gastric juice. Malt liquors and good wines are to be preferred. When we meet with acute exacerbations of the articular inflammation, it may be advisable to limit the amount of food and stimulants; but, generally speaking, the more nutritious the diet the better for the patient.

Treatment by Drugs.—Certain drugs have been at one or another time lauded as having a direct influence in combating the disease-process.

Some observers have found benefit from the salicylates. Speaking of their use in this disease, R. P. Howard[1] says: "Judging from my own late experience, and from the results obtained by Sée and other French physicians, sodium salicylate given in sufficient doses promises to be more generally useful in the more acute forms or in the actively inflammatory periods and exacerbations of the disease than any other agent. Including Sée's cases, Compagnon[2] has related 17 examples of rheumatoid arthritis, most of them of the general progressive form, in which great improvement as regards pain, stiffness, swelling, and even deformity, promptly followed the employment of that salt, even after the failure of other remedies. It proved signally useful recently in a rebellious chronic case of my own. . . . . It is hardly necessary to say that it often fails in this intractable disease, but it has frequently

[1] *Loc. cit.*

[2] *De l'Utilite du Salicylate de Soude dans le Traitement du Rheumatisme*, par Jules Compagnon, Paris, 1880.

relieved the pain and swelling and arrested the progress of it, at least for the time, even when alkalies, iodine, and arsenic had failed."

In the usual chronic forms of rheumatoid arthritis I have never seen any benefit follow the use of the salicylates. In the acute exacerbations, however, which are not infrequent, it is certainly desirable that they should be employed, as the above-quoted testimony from observers of great experience and acumen shows that they are of benefit. It is necessary, however, to give the salicylate in the usual full doses that we employ in acute rheumatism. The treatment should be continued for some time after the acute inflammatory symptoms have passed away.

Iodine and the various iodides are commonly held to have a marked influence for good in rheumatoid arthritis. Iodide of iron is especially lauded as an agent of great value. Sir Alfred Garrod and Dr. A. E. Garrod look upon it as the most efficient drug that we possess. It is, however, probable that its usefulness depends mainly on the iron and not upon the iodine. It therefore properly belongs to the category of agents referred to as being of value owing to their power in improving the general state of nutrition.

Whether iodide of potassium or free iodine has any direct influence over the course of the disease it is difficult to prove or disprove.

In a disease of such an intractable nature as the one under consideration it is no wonder to find a very numerous list of alleged remedies. The alkalies, quinine, cimicifuga racemosa, fraxinus excelsior, colchicum, and many other drugs have been and still are recommended as being useful. From what we know of the nature of the disease, it appears clear that there is no remedy which can be said to have any direct influence over the course of the disease.

There remain to be considered two general measures of considerable importance—viz. electricity and mineral baths.

Electricity.—Both the galvanic and faradic currents are employed, and both are used with a double object: first, to influence the general nutritional state, and, secondly, to affect favorably the articular affections. Remak and M. Meyer were among the first to use galvanism in a general way: the latter asserts that he succeeded in arresting the downward progress in several cases through galvanization of the sympathetic. Erb,[1] who has treated a large number of cases by means of galvanization, has had no absolute cures, but he has met with occasional good results as far as improvement of the general state of nutrition and the local trouble is concerned. He considers that it is better to employ galvanism direct to the spine than to the sympathetic. When the upper extremities are mainly affected, he passes the current through the cervical cord, and when the lower extremities are the principal

[1] *Handbuch der Electrotherapie*, S. 648.

seats of the rheumatic affection, the current is passed through the lumbar cord. The stabile current is employed daily, and the sittings should be from ten to fifteen minutes in duration. It is recommended to continue the treatment several months at least, but it is seldom that we meet with people who have patience for such a prolonged course of treatment.

A. E. Garrod, in his recent work, quotes the experience of Dr. Steavenson with the electric bath in the treatment of rheumatoid arthritis. He uses a bath-tub made of some non-conducting material, as wood or porcelain, and has it filled with water at about the normal temperature of the body. A copper plate connected with the negative pole is placed at the foot of the bath, and a similar plate at the head is connected with the positive pole. A galvanometer measuring at least 250 milliampères is used. The strength used is about 200 milliampères, and it is computed that only 40 pass through the body, while the remainder pass through the water. The full current of 200 milliampères is passed for about ten minutes. During the first six days a daily bath is given, and afterward on alternate days until the course decided upon has been given.

Dr. Steavenson considers that electric baths have a favorable influence over the course of the disease, and he cites instances which appear to support his supposition.

The Bath Treatment.—The treatment of rheumatoid arthritis by means of thermal baths is of great importance. Indifferent thermal waters appear to be as effective as those containing salts of various kinds; hence it is clear that the success depends almost entirely on the temperature of the water. Both natural and artificial thermal baths are employed. The former, however, are, as a rule, to be preferred, as the general regimen and hygienic conditions enforced at these places are factors of importance in the great relief which patients often obtain. The practice very common in this country of patients of their own accord resorting to Turkish-bath establishments, and taking one or more baths daily for several successive days, is one which often does more harm than good. Any measures which tend to lower the general state of nutrition will invariably do harm in this disease.

At Aachen in Germany special attention is paid to the treatment of rheumatoid arthritis by means of douches and massage in conjunction with general baths. Rademaker[1] of Aachen has found marked benefit to follow this treatment even in advanced cases. He considers a temperature higher than 97° Fahr. as injurious, owing to its debilitating effects and to its tendency to increase the already existing too-free action of the skin. Massage and douches are made use of only when the joint affection is in a quiescent state. The latter means, in his

[1] *Aachen als Kurart*, S. 111.

experience, has been found of particular benefit in the monoarticular forms of the disease.

In employing thermal baths it is a good rule to counsel the patient not to take them oftener than every other day, and to continue until fifteen to twenty are taken. It is not unusual to meet with a slight increase in the joint-pain after a few baths. This, however, usually disappears before the entire course is completed. If the aggravation is marked, the treatment should be discontinued. It is important to take note of individual peculiarities. Some patients are soon and greatly benefited; others are quickly made worse. Between these two extremes we find all possible degrees of difference.

In some cases the thermal alkaline waters appear to be most effective, while in others the sulphur thermal waters give most relief. No definite rules can therefore be laid down for the waters best adapted for each case.

The thermal waters of Wildbad, Carlsbad, Wiesbaden, Töplitz, Aix-les-Bains, and Bath in Europe, and of Arkansas, Virginia, and Banff in this country, are all useful in suitable cases. The chalybeate mineral waters of Langenschwalbach, Rippolsau, Spa, Franzensbad, etc. are useful when anæmia and debility are prominent symptoms.

GOUT.

THIS subject will be considered under the following heads:

I. The treatment of the disordered state of nutrition that leads to the development of gout in its many phases.

II. The treatment of the various lesions and functional disturbances which arise from this disordered state of nutrition.

THE TREATMENT OF THE DISORDERED STATE OF NUTRITION.

Our knowledge of the intimate nature of gout is still far from perfect. As proof, we have only to refer to the very numerous hypotheses advanced from time to time to explain its cause. Functional derangements of the liver and kidneys and degenerative changes in the fibrous tissues have each their supporters. The humoral and the neurotic theories with other observers hold sway. All these theories, individually, fall short of explaining the protean manifestations of the disease. Whatever may be the ultimate cause, there is a concensus of opinion that in certain dietetic and hygienic measures we have important means of controlling not only the usual periodic outbreaks, but also to a certain extent of preventing them.

The Diet in Gout.—It is of importance to give the patient strict rules not only as to the quality, but also as to the quantity, of his food.

In some cases the quality of the food is what particularly calls for correction, while in others the quantity requires special attention. Every case should be closely studied on its own merits. It is a routine practice to have a stated dietary both as respects quality and quantity for a gouty subject. Generally speaking, the reduction in quantity is of more importance than a change in the quality. A diminution in the quantity of food is especially called for in cases of corpulent patients. In a general way, it is always well to insist on the patient never fully satisfying his appetite.

As to the quality of food specially adapted for gouty patients, authorities differ. Some are inclined to look upon the albuminous elements as the most injurious, while others consider the carbohydrates fully as bad. Both of these contentions are in certain cases correct. It is an indisputable fact, however, that in the vast majority of cases an excess in the nitrogenous elements is what we have mainly to direct our attention to. A certain proportion of nitrogenous food is, however, necessary for the needs of the organism. Meat should not be partaken of more than once in the day. The practice of requiring a man who has attained middle age, and with it gout, to live for months, and even years, afterward as a strict vegetarian is not wise. It is only in young subjects that a total change of diet can be followed with impunity to the general health. In advising a patient as to the amount of nitrogenous food he is to take, it is important to consider his habits and occupation. If he is an indolent man, the quantity should be very small, while an active, busy man may be allowed to take more. White meats are to be preferred to those which are brown, and of forms of cooking roasting is the best. As to other varieties of nitrogenous food, they should generally be used very sparingly. Fish, oysters, and game should especially be taken in moderation. When a patient takes a quantity of butcher's meat once a day, he should take little else of an albuminous character that day. It should be pointed out to him that he must diminish the total quantity of his albuminous food, and he should be supplied with printed directions showing what to avoid both as to quality and quantity.

Fatty articles should also be taken sparingly. When used in excess they interfere with the metabolism of the albuminates. In corpulent gouty patients excess of fatty food is particularly injurious, owing to its action in interfering with cellular activity. It therefore tends, when taken with albuminates, to make the corpulent more corpulent. For a gouty corpulent patient nothing can be worse than excess of albuminous, fatty, and starchy food. In the dietetic treatment of gout it is especially necessary carefully to consider the individual peculiarities of each patient. If the general state of nutrition is lowered, it will be necessary to allow a fair amount of fat, not only for its nutritive value,

but also from the fact that it is not then necessary to give the albuminates and carbohydrates in more than very small quantities. Where the digestive acts are normally performed there is less objection to fatty food than where these acts are abnormal.

There is considerable difference of opinion as to the advisability of allowing gouty patients carbohydrates to any extent. It is generally admitted that carbohydrates in excess are more injurious than fat in excess.

Speaking of the use of sugar in gout, Sir Dyce Duckworth[1] says: "It is not proved that sugar by itself is harmful to the gouty; but there is evidence to show that if it be freely taken in addition to a varied and mixed diet, especially with certain articles and with wine, an imperfect fermentative process is set up in the stomach and small intestines which tends to provoke flatulency and acidity. *It is therefore in this manner that sugar proves harmful to those disposed to gout.*"

As a rule, it is found that saccharine fruits are injurious to the gouty when taken in any considerable quantities. Jams, tarts, and similar foods should be avoided. With regard to other varieties of fruits there is great discrepancy in the practice of different authorities. Some maintain that fruits of all and every kind, raw or cooked, are suitable (Fothergill, Burney Yeo). Sir Dyce Duckworth, Sir Andrew Clarke, and Dr. W. H. Draper, on the other hand, consider fruits generally as injurious. Sir Andrew Clarke[2] goes so far as to forbid absolutely all kinds of fruit to gouty patients. It is difficult to arrive at a true conclusion in the face of these very conflicting opinions. That there are cases where fruits of all kinds act injuriously is a common experience, but probably we as frequently meet with cases where they do no harm, as far as we are able to judge. Provided fruits do not cause any gastric or intestinal disturbance, it is our practice to leave the matter with the patient. If it is found that they can be taken with a present impunity, and if there is appetite for them, we believe they can do little harm. If, on the contrary, symptoms of gastric or duodenal dyspepsia arise, fruits should be forbidden. We believe that this practice is more rational than either of the extremes we have referred to. It remains to be proven in the case of gout that any one of our great group of food-stuffs is in all cases and at all times injurious.

Certain vegetables should be used sparingly, if at all, by the gouty. Asparagus, sorrel, rhubarb, and tomatoes are especially injurious, because they contain oxalic acid. The addition of sugar to these acid vegetables only intensifies their injurious effects. Spinach is usually admitted to be wholesome for gouty patients, in spite of the fact that it is an acid vegetable. Its harmlessness is probably due to its indigestibility and

[1] *A Treatise on Gout*, 1889. [2] Quoted by Sir Dyce Duckworth.

to its purgative action. Onions, celery, turnips, and carrots should be used in moderation. Potatoes, peas and beans, green corn, cucumbers, and plain lettuce can be used with considerable freedom. Nuts of any kind should not be allowed.

What fluid should those who are goutily predisposed drink? This is a question of great practical importance. It is one easy to answer, but it is difficult for most gouty patients to follow the physician's instructions in this respect. It is much easier for the average gouty man to dispense with certain articles of diet than for him to give up entirely his favorite beverage. It is universally recognized that alcohol in all its forms tends to the development of gout where there is the least predisposition. Gout is certainly to be met with in those who have always been total abstainers, but this fact does not in the least disprove the result of the accumulated experience as to the gout-producing tendency of alcohol.

Total abstinence, then, is good advice to give to all young persons who have an hereditary tendency to gout. The same advice is applicable to the great majority of gouty patients, no matter what their age may be. Practically, however, we meet not unfrequently with patients who think that they cannot get along without alcohol in some form, and for this class we have to make choice of those alcoholic drinks which experience has shown to be least harmful. It is difficult in any case for the physician to decide this point. Every man is a law unto himself as far as the use of stimulants is concerned. We therefore have to rely mainly on what the patient has found to be distinctly injurious, and what, on the other hand, he can take with impunity.

The injurious effects of alcoholic liquids vary very greatly in different individuals. Port wine is generally looked upon as the most injurious. It is said that its continuous use may originate gout where there is no hereditary tendency to this disease. The reason for the deleterious action of port wine is the imperfect fermentation, alcohol being added to it before fermentation is complete, in order to give it "keeping power." All strong and sweet wines are also distinctly injurious to the gouty. Champagnes, sherries, Burgundy, Madeira, the different Rhine and Moselle wines, should be carefully avoided. Owing to its complete fermentation, good Bordeaux wine is the least harmful for gouty patients. Beer, porter, and stout are also great enemies to those goutily predisposed, especially when taken daily and in excess at intervals.

E. Pfeiffer[1] has shown the marked influence that both wine and beer have on the elimination of uric acid. He estimated the amount

[1] *Die Natur und Behandlung der Gicht* (Verhandlungen des Congresses für Innere Medizin—Achter Congress, 1889), S. 199.

of this acid excreted daily in the urine of persons living under normal conditions without the use of any stimulants, and found that it varied very slightly from day to day. When he gave his subjects a quantity of either beer or wine at the midday or evening meal, he found a marked diminution in the quantity of uric acid excreted. Usually it was found diminished one-half. On the following day the quantity of uric acid was found to be greatly increased, a quantity sufficient to correspond to the previous diminution. On the next day it was found that the uric acid was again eliminated in decreased quantities, showing that the influence of the beer and wine extended over a period of four or five days. These experiments show the deleterious influence of an excess of wine and beer in healthy persons. It is a natural inference that in the gouty the disturbance of elimination would be much greater.

To explain the much greater injurious influence of wine and beer in the gouty, it is necessary to eliminate the alcohol as being the active factor. It is well known that certain strong alcoholic drinks, as brandy, whiskey, and rum, have much less injurious influence than either beer or wine. No doubt alcohol in all forms tends to lessen the elimination of both urea and uric acid.

The experiments of Ries, Munk, v. Jaksch, and Hammond show conclusively that alcohol is powerful in preventing the elimination of tissue-waste. It is, however, the acids in beer and wine that are the most injurious. The action of acid substances in diminishing the amount of uric acid excreted has been demonstrated time and again. The uric acid is not only diminished, but the urates are got rid of mainly in the form of uric acid. By the exhibition of acids to persons in good health it is possible to bring their urine to the state we find it in persons who are at the time suffering from a paroxysm of gout. This is a sufficient explanation of the now universally recognized deleterious influence of beer and wine.

When we meet with patients who truly believe that it is impossible for them, without the greatest discomfort, to get along without alcohol in some form, we have to make choice of that variety which experience has shown to be the least injurious. When obtainable, fine old Scotch whiskey or good French cognac should be our choice. They, however, should always be taken freely diluted with one or other of the alkaline waters. In every case we should take into careful consideration individual peculiarities. Whiskey or brandy may in exceptional cases be the most injurious of all alcoholic beverages.

Milk.—There are differences of opinion as to the harmlessness of milk for the gouty. If it is digested without difficulty, it not only is a good drink, but an excellent food. It is, however, not uncommon to meet with patients who dislike the taste of milk or who are unable

to digest it without difficulty. In the latter class the difficulty may be overcome, as recommended by Burney Yeo. He advises his gouty patients to drink, about ten minutes before their first meal, a breakfast-cupful of hot milk and water, to which a small salt-spoonful of the bicarbonate of potassium and the same quantity of table salt have been added. It is advisable to use skimmed milk, as we in this way get rid of most of the objectionable constituents, the fat and the sugar.

Water.—On scientific grounds we would be disposed to look upon water as the best of all beverages for the gouty, and, as far as we can judge from experience in the treatment of this disease, we see no reason to change that opinion. No less an authority than Sir Dyce Duckworth looks upon water with little favor as a beverage for the gouty. He says:[1] "I feel sure that Sydenham was right in condemning water-drinking for the gouty. Water alone is bad and dangerous, as I know from personal experience. When taken as the regular drink from youth upward it is beneficial. Herein lies a great clinical fact which needs to be duly considered, especially at the present time."

It would have been desirable to have had some clear statement from the distinguished author quoted as to the probable or possible ways in which water may prove injurious. We can readily understand how too much water taken with the meals may so disorder the digestive process as to lead to difficult digestion, and thus indirectly bring about a disturbance of the normal elimination of tissue-waste.

The practice of drinking several ounces of hot water three or four times daily about half an hour before meals and at bedtime we have found to be of benefit. Burney Yeo, in his work on *Food in Health and Disease*, gives a copy of a diet followed by a medical man who suffered from gout and gravel. This patient always found that he would have gouty symptoms when he indulged in meat or game, or when he took more than the usual amount of claret, or when he omitted to take one or two glasses of hot water.

The special characters of the foregoing dietary are the small quantity of nitrogenous food taken and the large quantity of water. We have, on the one hand, lessened nitrogenous waste from the small amount taken, and, on the other hand, an excellent diuretic to wash the waste away.

Tea, Coffee, and Cocoa as Beverages in Gout.—Tea, coffee, and cocoa can be taken by the gouty, provided the amount of sugar used is small. In some cases it is found that both tea and coffee induce dyspepsia, and in this indirect way they may prove harmful; but when taken moderately weak and not in too great quantities, it is very exceptional to meet with dyspeptic symptoms.

On the Use of the Different Natural Mineral Waters in the

[1] *A Treatise on Gout*, p. 425.

Treatment of Gout.—Next in importance to dietetic measures comes the use of certain mineral waters in the preventive treatment of gout. It will be convenient in this connection to consider also the various auxiliary means used at bathing establishments in the treatment of gouty subjects.

A great variety of mineral waters are recommended in the treatment of gout. Sir Dyce Duckworth says there are at least eight varieties or classes of springs recommended for this purpose. We have—(1) the pure and indifferent waters; (2) alkaline; (3) alkaline and saline; (4) bitter-acidulated; (5) saline; (6) sulphurous; (7) bromo-ioduretted; and (8) ferruginous. There are certain cases and certain states or conditions not unfrequently met with where one or other of the above waters will prove useful.

Of all these waters the alkaline and saline are the most important. Through the internal administration of the alkaline carbonates we increase the elimination of uric acid, which nearly always appears as a salt and not free.

Pfeiffer considers that of all German mineral waters the Fachingen water is the best for gout. It contains 3.5 per cent. of sodium bicarbonate and 6 per cent. of bicarbonate of lime. It also contains a greater percentage of the above salts than any other German mineral waters. It is pleasant to the taste, and is readily tolerated by the stomach, and, what is of considerable importance, it is cheaper than any other water. Pfeiffer also speaks favorably of the use of Kaiser-Frederick mineral water in gout.

The Carlsbad waters in Bohemia have long been famous in the treatment of gout, especially in the robust and corpulent. The waters can be used with advantage at home, but to obtain the full benefit it is necessary that the patient should take a "regular course" at Carlsbad. It is only in this way that the full benefit of the combined hygienic, dietetic, and hydrotherapeutic effects is obtained. There is no doubt that the strict dietetic regimen carried out here and in similar places is an important factor in the treatment. Carlsbad waters contain principally sodium sulphate, bicarbonate, and chloride. They are thermal waters, the temperature of the different springs varying from 120° to 160° Fahr. The imported waters may be taken, on rising in the morning, in doses of 4 or 5 ounces in an equal quantity of warm water. A course at Carlsbad extends over three weeks, and it is the usual custom to recommend gouty patients to take two courses every year for three successive years. Such a plan of treatment can of course only be made use of by those who have wealth and leisure.

The Marienbad waters have about the same composition as those of Carlsbad, and can be used in the same way. The amount of the sodium sulphate is considerably greater in the Kreuzbrunnen than in the

Carlsbad water. This may be an advantage in some cases, and a distinct disadvantage in other cases. Old people are often injuriously affected by a too prolonged use of the waters.

Vichy water is of great repute in the treatment of robust gouty patients. It is not adapted for the weakly and anæmic. It contains more sodium bicarbonate than the Fachingen waters, and about the same quantity of sodium chloride.

Vals water contains more sodium carbonate than any other alkaline water, and is therefore well adapted for those cases in which the tendency to uric-acid formation in excess is very marked.

In the United States and Canada there are several alkaline-saline mineral waters of importance. The best known are those at Saratoga in New York State. Besides chlorides of sodium and the alkaline carbonates, they contain a large quantity of carbonic acid, which renders them agreeable. The St. Clair Spring in Michigan and the Caledonia and St. Catherine Springs in Ontario are also useful alkaline-saline waters.

In England the Bath and Buxton waters are of great use in certain cases of gout. They are indifferent waters, and are especially adapted for cases of gout in the weakly.

There has been much speculation as to the mode of action of mineral baths in gout The most complete experiments made to determine this point are those of Pfeiffer[1] of Wiesbaden. After a series of twenty warm baths (thermo-saline of Wiesbaden) at a temperature of 93° Fahr. in healthy persons there was never found any essential difference in the amount of uric acid eliminated. Previously to the beginning of the experiments the uric acid was mainly found united, but after twenty baths it was almost invariably found free.

After treating gouty patients with a course of twenty similar baths it was found that the quantity of uric acid eliminated was considerably diminished as compared with the period before the use of the baths. It was usually diminished 50 per cent., and at times only a trace was discoverable. It was also found that the acid was in a state of combination after the employment of the baths, while previously it was nearly always in the free state. The uric acid remains often for several weeks in combination with a base.

Pfeiffer concludes from the observations narrated that the thermal water of Wiesbaden has a very marked action as a preventive of gouty manifestations. He is inclined to believe that the other commonly-employed thermal waters have a similar action, but he has no experimental evidence to sustain this supposition. It is probable that the saline constituents in these and other baths exercise an important influence—an influence distinct from the effect of the heat itself.

[1] *Op. cit.*

Ordinary hot baths have not the same influence. Occasional Turkish baths in patients who do not present any signs of degenerative diseases of the vessels are beneficial. They act by influencing the function of the skin and the general metabolism.

Climate.—It is well known that gout is a comparatively rare disease in warm climates. The reason of this is partly that the method of diet is different, but there is no doubt that the warmth is an important factor. In very stubborn cases it may therefore be an advantage for a patient to live, at least during the winter months, in a warm climate.

Exercise.—In the preventive treatment of gout it is of great importance that all patients who are able to do so should take considerable and regular exercise. Regular exercise promotes metabolism and secures the proper performance of the functions of the different eliminating organs. Therefore tissue-waste is thrown off. Where outdoor exercise is not possible massage should be employed. It is of importance also that gouty subjects should have regular mental work.

Medicinal Treatment of the Constitutional State in the Gouty.

The employment of medicinal agents is important at times as an addition to the dietetic and hygienic treatment of the gouty constitutional state. It is, however, the duty of the physician to make clear to the patient that his safety essentially lies in a strict adherence to the dietetic and hygienic measures already sketched out, and that drugs at best are only of use occasionally to meet some special symptomatic indication. Where we have evidence of deficient metabolism the use of alkaline and hæmatic agents for short periods at a time is beneficial. The alkalies promote metabolism and prevent the deposition of uric acid. The potassium and lithium compounds are generally thought to be more effective than those of sodium.

The amount of lithium contained in certain natural mineral waters is too small to be of any value. The salts of this alkali have therefore to be employed. The hippurate will be found to be a convenient way of giving this agent. It may be prescribed as follows:

℞. Lithii hippuratis, ʒj;
Syrupi aurantii, ℥j;
Aquæ, q. s. ad ℥vj.—M.
Sig. A table-spoonful in water at bedtime.

As a rule it will not be found necessary to administer this or any alkaline salt more frequently than once in twenty-four hours.

The carbonate, citrate, or guaiacate of lithium may be used in

the same doses as the hippurate. The granular effervescent salicylate of lithium is a pleasant way of giving this agent.

Of the potassium salts the carbonate and the citrate are the most eligible.

In the administration of alkaline agents it is important to remember that they should only be given on an empty stomach and freely diluted. The practice of giving alkalies after meals must interfere directly with gastric digestion.

Iron is an agent which not infrequently is called for in the treatment of chronic gout. The indications for its employment are the existence of anæmia and albuminuria. Probably the most efficient form in which to give iron in chronic gout is the ferruginous mineral waters, especially those which contain also a good proportion of alkali-saline ingredients. The Pyrmont waters may be taken as a type of the more important mineral waters of this class. They contain iron in the form of the bicarbonate, and the sulphates of magnesium, potassium, and sodium, and small quantities of the chloride of lithium, sodium, and ammonium.

When these waters are not to be obtained, iron may be given in a form which closely resembles the more important ingredients of those waters—*i. e.* small quantities of iron with a sufficient amount of the purgative alkalies to prevent the constipating effect of the iron compound. The following combination practically fulfils this:

℞. Ferri sulphatis, gr. xij;
Magnesii sulphatis, ℥j;
Infusi calumbæ, q. s. ad ℥vj.—M
Sig. A tablespoonful once or twice daily.

Unless combined with purgatives the ferric salts are apt to bring about acute attacks of gout, as they check the elimination of uric acid.

Arsenic is a useful agent in the anæmic and debilitated states attending gout. It has a marked influence over metabolism, and further it has a direct hæmatic action. It can be prescribed either in the form of Fowler's solution or as arsenious acid.

For the constipation so frequently complained of by gouty patients we have found no remedy better than cascara sagrada. It is a simple, mild, and efficient aperient.

Iridin also, with small doses of aloes, is a useful combination for constipation. No matter what simple or cholagogue purgative is used, it should be followed occasionally by some natural bitter water.

Acute Gout.

The acute arthritis is the most important external local manifestation of the gouty constitutional state. In the treatment of this con-

dition the general principles of the treatment of an acute local inflammation are our main guides. In all cases, whether the inflammation is mild or severe, rest is of first importance. The limb should be kept quiet and elevated. In olden times a not uncommon practice was to direct the patient to "walk off" his gout. A recent writer contends that in the majority of cases this is the proper practice to follow. It is directly against what we conceive to be the only proper way. "Walking off" the gout is an attempt to treat the constitutional state when it is too late as far as the present attack is concerned.

Local analgesics of various kinds may be employed to give temporary relief. Sir Dyce Duckworth speaks approvingly of the following local analgesic:

℞. Atropinæ, gr. iij;
Morphinæ hydrochloratis, gr. xv;
Acidi oleici, f℥j.
Solve ut ft. linimentum.

Sig. To be painted over the painful joint with a large camel's-hair brush, and carded cotton to be superimposed, with a towel bandage.

The same author has found the following liniment, recommended by Garrod, to be very useful:

℞. Liniment. belladonnæ, f℥iij;
Morphinæ hydrochloratis, gr. x.
M. et ft. linimentum.

Sig. A tea-spoonful to be mixed with a table-spoonful of hot water, and applied on lint under oiled silk every four hours.

An ointment of ichthyol is one of the most effective agents for relieving the pain attendant on local inflammations. Cocaine, menthol, and camphor-chloral will also be found useful in allaying the pain of acute gouty arthritis. Occasionally patients find greater relief from warm fomentations than from anodyne applications. Blistering at some distance from the inflamed joint was a practice formerly in vogue. Local bloodletting is never resorted to at the present time.

Internal Treatment.—As to the use of internal agents in the treatment of acute gouty arthritis, there are two schools, holding different views. We have, for instance, the school which maintains that there is no trustworthy agent, and that the proper treatment in such cases is a judicious local treatment, coupled with the administration of agents which stimulate the functions of the eliminating organs, and a strict adherence to a proper diet.

Secondly, we have that school which places its reliance mainly on

colchicum. The alleged influence of the latter agent will be first considered.

From time immemorial colchicum has been used in the treatment of gout. The testimony in its favor is overwhelming. The preparation usually employed is the wine of the root. There are some advocates for the wine or tincture of the seeds. The latter preparations are more irritating to the gastro-intestinal mucous membrane than is the former. The dose of the wine of the root varies from 10 to 30 minims. A good practice is to begin with a comparatively large dose—20 minims—and continue the same dose until either relief is obtained or the irritating effects of the drug on the gastro-intestinal mucous membrane are apparent. Another practice, which is often efficient, is to give a single large dose at night and two or three small doses during the day—40 minims at bedtime and 5 minims at intervals of four hours during the day.

Colchicum is thought to be more effective by Lauder Brunton[1] when it is combined with purgatives or when the bowels have been previously freely acted upon. The following combination is considered valuable:

℞. Vini colchici, ℥ss;
Magnesii carbonatis, ʒj;
Magnesii sulphatis, ℥ss;
Aquæ menthæ piperitæ, q. s. ad ℥vj.—M.

Sig. A tea-spoonful to be taken every four hours while the pain is troublesome.

We possess no definite knowledge as to the mode of action of colchicum in gout. The following explanations have been at various times advanced:

1. That it acts through promoting elimination by the gastro-intestinal mucous membrane and kidneys.

2. That its action is mainly to be explained by its direct cardiac depressant effects.

3. That it acts principally by increasing the hepatic metabolism.

4. That it inhibits the ferments which give rise to the production of uric acid.

5. That, owing to the induction of paralysis of the afferent nerves the effects of the irritation of the uric acid on these structures are not felt by the patient.

6. That it has a direct antidotal action on the cause of the arthritis—that, in other words, it is a specific in the same sense as is quinine in malarial fever and the salicylates in acute articular rheumatism.

[1] *Pharmacology and Therapeutics*, p. 1051.

In the present state of our knowledge it is impossible to determine what part is taken by the different actions referred to. It is highly probable that it acts in several ways. A point of great practical importance is that we may obtain the beneficial effects of colchicum in gout without producing either increased diuresis, vomiting, purging, or a cardiac depressant effect. This certainly lends great support to the hypothesis that it has a direct specific effect.

The Salicylates in Gouty Arthritis.—During the past decade a number of articles have appeared on the value of the salicylates in gouty arthritis, especially in its more acute forms. M. Germain Sée, Latham, Jaccoud, Haig, and Ralfe all strongly advocate the employment of the salicylates, considering them fully equal, if not superior to, colchicum. Speaking of the use of salicylic acid in gout, Sir Dyce Duckworth says:[1] "It does not always afford relief so rapidly, even when successful, as does colchicum, and not till after a day or two is its efficacy appreciated, at all events by the patient. In some cases, however, it acts promptly and decidedly. I do not think it is likely to supersede the well-established action of colchicum as a prompt deliverer from the agony of a gouty paroxysm; but it is a remedy of considerable power and usefulness by favoring excretion of uric acid and preventing other acids in the system from causing retention of the latter."

To obtain relief from the salicylates it is necessary to give them in fairly full doses. Haig[2] considers that it is of little use to give the salicylates in less quantities than one drachm in twenty-four hours, and frequently it may be necessary to give as much as a drachm and a half, or even the quantities usually prescribed in severe cases of acute articular rheumatism. When given in these large doses Haig has never seen it fail to bring speedy relief.

The salicylates should be avoided if there is any evidence of inflammatory or degenerative disease of the kidneys.

It is claimed by Haig that the salicylates act by increasing the elimination of uric acid. He thinks that the salicylic acid seizes upon the uric acid and gets rid of it in the form of a soluble salicylurate.

The Alkaline Treatment of Acute Gout.—Alkalies are of value in relieving not only the arthritic symptoms present in an acute gouty attack, but they also tend to remove or lessen the amount of uric acid present in the blood. The potassium and lithium salts are those which are usually found the most effective. Salts of either can be used alone or in combination with colchicum or salicylic acid. Certain popular nostrums for the relief of gout are combinations of all three. The hippurate or salicylate of lithium, in doses of 15 grains three or four times a day, may be relied upon as being generally efficient.

[1] *Treatise on Gout*, p. 359. [2] *St. Bartholomew's Hospital Reports*, vol. xxv.

Whatever alkaline salt is prescribed, the dose should be lessened as the acuter symptoms pass away. Garrod in the subacute cases strongly recommends a combination of quinine with the alkalies.

Iodide of potassium, manganese, trimethylamine, veratrine, and many other agents have been at one time or another highly spoken of for the relief of acute gouty paroxysms. They are all, however, much inferior to those already considered.

The Dietetic Treatment of Acute Gout.—There is little to be said under this heading. The diet should be in general such as has been recommended between the paroxysms. If the patient is obese and robust, nitrogenous food should not be allowed on any account. In elderly persons with deficient resisting powers fish and white meats should be taken.

The cases of acute gout in which alcoholic stimulants are necessary or desirable are extremely few.

The Local Treatment of Chronic Gouty Arthritis.—When gouty arthritis has become chronic, the nature of the local treatment will depend mainly upon the presence or absence of pain. Stiffness of the joints is nearly always present, and if pain is considerable it is not advisable to employ very active measures. Passive motion and friction with stimulating liniments are the means employed to counteract both the true and false ankyloses which occur in the course of chronic gout.

The uratic deposits found in various parts in very chronic gout require no special treatment. As a rule, the less they are interfered with the better, meddlesome surgery being especially to be deprecated in these cases. If the uratic deposits break down into pus, then they are to be dealt with on general surgical principles.

Retrocedent Gout.

When retrocedent gout is diagnosticated, it is the recognized practice to endeavor to bring on an arthritis, as in this way the severe internal manifestation is relieved. A simple and successful way of starting a gouty arthritis in one or more of the joints of the feet is to make use of a hot mustard foot-bath. Whatever general symptoms may be present are to be dealt with on general physiological principles.

SCURVY.

By JOHN B. HAMILTON, M. D., LL.D.

The disease known as scurvy by reason of improved dietetics is now encountered infrequently in comparison with earlier times. The disease is due to *omissions* of certain articles of diet, rather than to the *consumption* of injurious ones. The scope assigned to this article, however, forbids an extended discussion of the causation of the disease, and permits the mention of only so much of its symptomatology as may be necessary to speak properly of its therapeusis.

History, Prevalence, and Nature.

Scurvy has been known from the earliest times, as it was distinctly mentioned by Strabo, book xvi., wherein he describes the diseases affecting the army of Aëlius Gallus, sent by Augustus to Arabia; and Pliny, in describing the disease which affected the Roman army under Cæsar Germanicus, has given a fair description of its ravages. Joinville, in his history of St. Louis, gives a very satisfactory account of it. The passages of Hippocrates referring to scurvy are somewhat doubtful. In his book on "Airs, Waters, and Places" he speaks of persons who drink certain waters as having "large and obstructed spleens; their bellies are hard, emaciated, and hot; their shoulders, collar-bones, and faces are emaciated, for their flesh is melted down and taken up by the spleen; hence they are slender. Such persons, then, are voracious and thirsty; their bellies are very dry, both above and below, so that they require the strongest medicines."

In his book on Prorrhetics he says: "Those who have bleeding at the nose, although they may appear to be otherwise in good health, will be found to have a large spleen, or pain in the head, or flashes of light before their eyes. Most of these patients have both headache and affection of the spleen. The gums are diseased and the mouth fœtid. Persons who have enlarged spleen are exempt from hæmorrhages and fœtor of the mouth, but have malignant ulcers on the legs and black cicatrices; but if they have any obvious deposit in the countenance, or if their speech be rough, or if they have toothache, a hæmorrhage from the nose may be expected. Those who have great swellings below the eyes will be found to have enlarged spleens. And if there come on

swellings in the feet, and if they appear to be dropsical, the belly and loins must be attended to."

Sprengel (*History of Medicine*) does not believe that passages from the ancient authors present the antiquity of this affection, but thinks that the first authenticated cases of scurvy occurred in the voyage which the Normans made under Thorstein, the son of Eric Raude, in 1002. Thorstein himself died of the disease. Sprengel gives full credit to the above-mentioned account of Joinville, wherein he describes the scurvy that attacked the followers of St. Louis during the year 1250 while on his journey to Palestine. He mentions that nasal hæmorrhage was a sign of inevitable death.

The fifteenth century, notable for its geographical discoveries, long voyages to the west, north, and south, to the islands and continents on the confines of the previously unknown sea, was marked also by great increase in the number of sick and deaths from scurvy.

Pierre Quirrino in 1431 made a voyage to the North Sea, but by reason of storms was carried out of his course, and for a long time was hovering along the Norwegian coast, unable to reach his port of destination. On reaching it many of the men were sick with scurvy.

In 1497–98 the famous voyage of Vasco de Gama, wherein he doubled the Cape of Good Hope, was rendered memorable by the death of fifty-five of his men from scurvy. Erysipelas was very frequent—knees and thighs were swollen and suppurating. The sick were afflicted with hæmorrhages and great pain.

The fleet of Cartier made a voyage to Canada in 1535, in the month of December, and was greatly afflicted with scurvy, and after having had a necropsy on the cadaver of a sailor the idea was conceived of utilizing the Canada pine as a remedy in this affection.

Sir Gilbert Blane, in his observations on the diseases of the fleet in 1781, refers to a ship called the Phœnix, taken from the Spaniards by Lord Rodney off Cape Vincent in 1780. Her woodwork was constructed of cedar and mahogany of uncommon thickness, and it was claimed, without being vouched for by Sir Gilbert, that this wood, used in her construction, increased her healthfulness.

Richard Hawkins, who lived in the beginning of the last century, mentioned that in twenty years he had known of ten thousand men who had perished by scurvy.

Commodore Anson in the course of his voyage of circumnavigation lost more than four-fifths of his men, chiefly by that disease. Notwithstanding this, with the true instinct of a sailor, he insists that "seamen in general are less subject to scurvy than marines and landsmen; which," he says, "seems to be owing to the greater activity of their life and the alacrity of their minds."

Sir John Pringle, however, usually refers to scurvy as "sea scurvy,"

and says: "By the scurvy I always mean the disease of sailors or of those who live in a moist air, eat salted provisions, have little milk or greens, and drink bad water and little or no fermented liquors."

The truth is, that the disease is neither confined to the land nor to the sea, but is always found where the vegetable acids are omitted from the dietary.

In the War of the Rebellion, among the white troops, during the five years covered by the statistics, 30,714 cases of scurvy were reported, and 383 deaths directly attributed to the disease. This is much less than was reported from the French army in the Crimea. The United States Sanitary Commission take especial credit to themselves for very much of the prevention of scurvy that was accomplished during this war. The farmers of the West were called on for contributions of vegetables, and vast contributions of vegetable supplies were received from Pittsburgh, Cleveland, Cincinnati, Louisville, and St. Louis, and the Western armies were also very largely supplied in a similar manner from outside sources, in addition to the regular supplies through military channels.

In the merchant marine scurvy is steadily disappearing, principally owing to two causes, one of which is the more rapid transit, substitution of steamships for sailing craft, greater speed of vessels, and consequent shorter voyages; and the other is the fact that most civilized nations require, by their laws, vessels sailing under their respective flags to carry certain articles of diet as a preventive of scurvy, and a clause to this effect is generally inserted in the ship's articles which the men sign before sailing.

The following is the section of the Revised Statutes of the United States giving the requirement mentioned:

"SEC. 4569. Every vessel belonging to a citizen of the United States, bound from a port in the United States to any foreign port, or being of the burden of seventy-five tons or upward, and bound from a port on the Atlantic to a port on the Pacific, or *vice versâ*, shall be provided with a chest of medicines; and every sailing-vessel bound on a voyage across the Atlantic or Pacific Ocean, or around Cape Horn or the Cape of Good Hope, or engaged in the whale or other fisheries, or in sealing, shall also be provided with, and cause to be kept, a sufficient quantity of lime- or lemon-juice, and also sugar and vinegar, or other antiscorbutics, to be served out to every seaman, as follows: The master of every such vessel shall serve the lime- or lemon-juice and sugar and vinegar to the crew within ten days after salt provisions mainly have been served out to the crew, and so long afterward as such consumption of salt provisions continues; the lime- or lemon-juice and sugar daily at the rate of half an ounce each per day, and the vinegar weekly at the rate of half a pint per week, for each member of the crew."

The following is a list of cases of scurvy treated in the marine hospitals of the United States and dispensaries from 1872 to 1890, inclusive:

Cases of Scurvy treated in U. S. Marine Hospitals and Dispensaries from 1872 to 1890, inclusive.

Year.	No. of Cases Scurvy.	All Diseases Treated.	Year.	No. of Cases Scurvy.	All Diseases Treated.
1872	18	13,156	1883	43	40,195
1873	47	13,529	1884	27	44,761
1874	59	14,356	1885	34	41,714
1875	25	15,009	1886	18	43,822
1876–77	89	31,983	1887	37	45,314
1878–79	24	39,155	1888	17	48,203
1880	39	24,860	1889	32	49,518
1881	42	32,613	1890	28	50,671
1882	55	36,184		634	585,043

Being a little over one per thousand for the period of eighteen years. Of these cases, more than three-fourths were reported from stations on the Pacific coast.

In logging camps, camps of charcoal-burners, and the like, where the diet consists almost exclusively of molasses, bread, and bacon, the writer has seen cases of scurvy; and even in farming regions, where vegetables are plenty, cases of scurvy not infrequently appear, due to voluntarily restricted diet and neglect of the most ordinary precautions.

In every instance in which scurvy has appeared at sea it has been found that the law requiring the issue of lime-juice has been disregarded, either designedly or from unavoidable causes incident to the voyage.

Recent investigations have confirmed the old view of scurvy being altogether a disease of alimentation, and all the symptoms may be such as are primarily referable to dietary errors. The nyctalopia and hemeralopia, and as well the occasional correspondence of scurvy with multiple neuritis, are certainly due to defective innervation. To this also may be due the hæmorrhages that occur over mucous surfaces throughout the body, the reopening of old cicatrices, the failure of repair in ulcers, and the extravasations that occur as purpuric spots in various parts of the body. The hæmorrhagic spots occurring on the body in cases of intestinal tuberculosis must also be considered as showing the scorbutic cachexia from lack of absorption of proper aliment.

Symptoms.

The prominent symptoms of scurvy are mental depression, steadily progressive emaciation, spongy and bleeding gums, hæmorrhagic spots on the skin, nasal, buccal, and pharyngeal hæmorrhages, sometimes

dysentery more or less acute, chronic diarrhœa, pain in the joints, and obstinate neuralgias.

"The results of the most recent analyses, those of Chalvet (quoted by Wales), are shown in the following table, in which scorbutic blood is contrasted with that of a healthy, robust female:

	Scorbutic Blood.	Healthy Blood.
Water	848.492	772.225
Solid matters	151.508	220.775
Dry clot	140.194	209.000
Albumin	72.304	68.717
Fibrin	4.342	2.162
Globules	63.548	138.121
Extractive matter—by absolute alcohol	10.312	8.013
" " by ether	1.002	1.300
Ashes of clot	3.000	5.691
Peroxide of iron of globules	1.060	2.259
Potassium of globules	0.329	0.625"

Post-Mortem Appearances.

Deaths from uncomplicated cases in the merchant marine are rare, as, unless in extremely advanced stages, the disease is amenable to treatment. The following gives the lesions observed in reported deaths from scurvy:

A patient with scurvy, having intercurrent pneumonia, died in the Marine Hospital at San Francisco in June, 1881, and there were found an abscess of the liver, hepatization of both lungs from recent pneumonia, an atheromatous condition of the first portion of the aorta, and hypertrophy of the left ventricle.

In a case dying in the Marine Hospital in St. Louis in 1881 the body was covered with purple spots and livid blotches, the lungs were much congested, there were purple spots on the pleuræ, and bloody fluid in the pleural cavity and pericardial sac, the heart and liver were very soft, the spleen was pulpefied, and the walls of the great vessels soft and friable; the intestines were congested, with patches of degenerated mucous membrane and livid blotches. There were infiltration and softening of the mesenteric glands.

In a case dying at the Marine Hospital at Vineyard Haven in 1882 purpuric spots were found on the abdomen, lower and upper extremities, and in the axilla. The peritoneum, lungs, liver, and intestines were dotted with hæmorrhagic spots. Bloody serum was found in the peritoneal, pleural, and pericardial cavities.

A case died in 1882 at the Marine Hospital in San Francisco in which the scorbutic spots were well marked; the posterior nares, upper part of the pharynx, and the upper end of the œsophagus were found in a state of gangrenous ulceration.

A case died in the Marine Hospital at New York in 1889, and the pleural and pericardial cavities were filled with fluid; both lungs œdematous, the liver fatty, and spleen hyperæmic on section. Both kidneys were small and showed chronic degeneration.

In another case, which died in the Marine Hospital in 1883, the blood oozed from the incisions on the cadaver almost as rapidly as from a living subject; the pleural cavities and pericardium contained a bloody effusion; both ventricles were full of fluid blood, and there was some bloody fluid in the large bronchi. The heart was flabby; the spleen unusually firm; kidneys anæmic, and a small amount of serous effusion was in the abdominal cavity.

It will thus be seen that the constant post-mortem appearance is that of degenerative changes in both the abdominal and thoracic viscera and extreme fluidity of the blood.

Treatment.

Scurvy is a strictly preventable disease, except when it occurs as a mechanical result of lack of absorption from previous intestinal disease. Special symptoms require treatment adapted to each case, but in all cases exposure to cold and wet must be counteracted as far as possible by suitable clothing and frequent changes. *Sameness of food* should be avoided by frequent changes in the dietary. Fresh vegetables in sufficient quantity should be a component part of all dietaries in armies, on shipboard, and in families. The use of compressed vegetables and compressed articles of diet for long voyages is specially recommended. It is well known that in the history of the voyage of the *Jeanette* and the various expeditions that were instituted about this time, scurvy was an unimportant factor, owing to the careful scale of provisions directed to be issued by the surgeon-general of the navy. Moderate bodily exercise should be taken, and the skin and emunctories kept open. Tonics are recommended, but quinine should generally be avoided. The writer has seen two patients in whom extensive hæmorrhage of the pharynx and mucous surfaces was produced by the administration of quinine, gradually ceasing on the withdrawal of the remedy and recurring again on its administration. This test would seem conclusive in establishing the existence of this idiosyncrasy.

Lime-juice seems to have a specific effect in the prevention of scurvy and as a curative agent when the scorbutic taint exists.

Potash in some of its forms is especially valuable. Dr. William A. Hammond, in *Military Medical and Surgical Essays*, states that "at Ceboletta, in New Mexico, where the writer was stationed several years, the men of the garrison never had scurvy originating in them at that place, although it prevailed very extensively at other posts in

the Territory. Upon analyzing the water in use it was found to contain a large proportion of potash, and to this fact the immunity from scurvy was attributed."

Potatoes, pickles, and sauerkraut, and the vegetables used as greens with vinegar, are valuable antiscorbutics.

Citrate of iron is a valuable remedy.

Vinegar and citric acid, while valuable as adjuvants to the dietary, are not curative.

Spongy and bleeding gums and ulcers are best treated by brushing them with a solution of boric acid with tincture of myrrh or catechu; and in cases of hæmaturia gallic acid in pill form, continued for several weeks, will be found advantageous.

In cases of great emaciation, rubbing the body with cod-liver oil, cotton-seed oil, or olive oil twice daily will be found useful.

The stiffened joints should be treated by gentle friction to stimulate the circulation, by massage, and by passive motion of the joints, each day extending the area of motion if possible.

General massage under the direction of a good masseur may sometimes be useful.

In cases in which the disease is so advanced that the patient cannot masticate solid food, fresh meats in the form of soups and broth should be administered, and auscultation of the thorax should be practised frequently to determine the presence or absence of effusion. Should there be at any time oppression of breathing from this cause, the fluid should be promptly evacuated by the aspirator.

DIABETES MELLITUS.

By FREDERICK A. PACKARD, M. D.

In considering the subject of the treatment of diabetes mellitus there are a few fundamental facts in regard to etiology that must of necessity form a prelude to the more immediate consideration of the efforts at cure. The affection itself can hardly be considered as more than a symptom, the primary causes of which are probably many of them as yet unknown, while others that are well established belong to several categories. The various theories as to the mechanism of perverted sugar transformation and assimilation are so elaborate, and have so little immediate bearing upon the actual treatment of the disease, that this division of the subject of etiology will not be considered even in abstract. The reader can find in almost all of the textbooks on physiology and the practice of medicine so full an exposition of the theories mentioned that it is not deemed advisable to introduce them into an article that has to do purely with methods for relieving those suffering from the disease.

Heredity is a factor in the causation of diabetes that is clearly established, and one that should be borne in mind in our endeavors at prophylactic treatment. This element has been illustrated time and again, and can be well seen in the table referred to below. Similar instances are given by many other writers that need not be enumerated. In this place may be mentioned the frequent occurrence of diabetes in Hebrews, possibly as a result of inheritance, possibly from some racial peculiarity.

The intimate relation between diabetes mellitus and gout has long been recognized, but it is in no way better illustrated than by a consideration of the genealogical table given by Charcot in his work upon the diseases of old age. In this are comprised the pathological facts regarding three generations of one family—the first containing one gouty individual; the second, four gouty and four diabetic sufferers; the third, one gouty. In the same table is clearly shown the uniform family characteristic of obesity, but the significance of the latter in the etiology of diabetes cannot be properly measured.

As at all events an exciting cause of the affection, a high place is to

be accorded to excessive mental anxiety or over-work—a fact that must be constantly borne in mind when we attempt to combat the disease, complete cure being often, if not as a rule, impossible without cessation of exacting mental toil.

Climate would seem, from the investigations of Purdy,[1] to be an etiological factor of considerable importance, as in his carefully-compiled statistics the disease presented a far higher rate of mortality in cold and moist than in mild and dry climates, while the death-rate increased with altitude. Of course, mortality statistics are not so trustworthy, from the point of view of etiology, as are those of morbility, but the interesting facts presented by the author mentioned will possibly open the way for some more definite knowledge upon the latter question. For our purpose the statistics are pre-eminently useful, as will be alluded to when we come to the choice of climate in treating the disease.

It is a well-recognized fact that certain diseases of the nervous system are frequently accompanied by the presence of sugar in the urine. It would hardly be appropriate in an article of this character to enter into a discussion of the various theories by which an explanation of this association is attempted, particularly as it would in no wise aid in guiding us toward the successful treatment of the affection.

For many years the occurrence of organic changes in the pancreas of those dying of diabetes mellitus has been recognized, these changes being of varied character and of different grades of severity. Quite recently, however, Von Mering and Minkowski have clearly and indisputably demonstrated the close relationship existing between the presence of glycosuria and the condition of this organ. In brief, their experiments demonstrate, as do also those of Lépine, that after complete ablation of the pancreas glycosuria and rapid wasting occur, although the incomplete removal of the organ has no such effect. From this it is argued, by a most convincing chain of reasoning, that the destruction of sugar within the organism is brought about by a peculiar ferment generated by the pancreas.

The administration of various drugs is capable of causing the appearance of sugar in the urine, but as this fact in no way bears on the present division of the subject, further mention of the phenomenon is unnecessary.

In addition to the causes already mentioned, it is claimed by some that malaria and syphilis may stand in an etiological relation to the disease. Several cases are on record in which a syphilitic new-formation was found pressing upon the medulla oblongata in patients who had been diabetics. As such cases are reported, it behooves us to remember the possible connection between the affections.

[1] *Diabetes*, Philada., 1890.

Finally, a not infrequent association is that between diabetes mellitus and the habitual ingestion of excessive quantities of food, particularly that of an amylaceous character. By this is meant not what might be called a physiological overflow of excessive carbohydrate ingestion, such as may occur in perfectly healthy individuals, but the excessive use of food that causes the balance of sugar ingestion, transformation, assimilation, and excretion to be upset more or less permanently.

In the following pages no attempt has been made to separate into distinct classes the various grades of severity of the disease, for the reason that practically the same rules apply to our management of all cases presenting this symptom, except in the matter of degree. That is to say, the same broad general rules are to guide us whether there be merely transient glycosuria, or the symptom be more marked, more constant, and associated with other phenomena making up the classic picture usually taken as the type of the disease.

As regards prophylactic treatment, but little can be said. When, however, certain members of a family have, so to speak, warranted us in looking upon the disease as a legacy, we may be able to so lay down rules of regimen and diet that other members not as yet affected may be saved from a similar fate. Of prime importance in such cases is the frequent periodic examination of the urine, in order that the first appearance of the results of imperfect elaboration and assimilation of the ingesta may aid us to avert the more pronounced evidences of the disease. Bearing in mind such exciting causes as are known to us, we should endeavor to prevent persons presumably so predisposed from engaging in any occupation in which sudden mental shock or long-continued and severe business anxiety may occur. For such an individual to undertake any enterprise involving large financial questions would possibly be extending an invitation to the onset of the disease, while in a humbler walk of life occupations should be avoided that may expose the individual to any severe mental shock; such, for example, as that of a railroad engineer, many of those so employed being victims of the disease (possibly from the prolonged mental strain and frequent presence of danger to which they are exposed). It can readily be appreciated that as the habitual overingestion of carbohydrate food may be a cause of permanent glycosuric tendency, it is particularly important in members of a diabetic family to keep well within the bounds of their capacity for appropriating such material. In the case of those who may have, possibly but transiently, passed glucose in the urine this precaution should be observed with much more care. The clothing in those included in this class needs careful attention, from the fact that as in other disorders of internal organs the sudden or habitual chilling of the surface may precipitate

an illness that might otherwise have been avoided or postponed. If the cause of the disease resides in the liver, such precautions are particularly necessary, just as is the case in the so-called "bilious tendency," which in many respects bears some resemblance to the disease under consideration. Woollen underwear of graded weight, with a sufficiency of outer clothing, must be insisted upon. In females particular attention should be paid to the manner of suspending the garments, so as to interfere as little as possible with normal abdominal circulation.

In the case of the patient who has already passed glucose in the urine the points above mentioned should be still more strictly enforced. Bearing in mind the few facts already known regarding the etiology of the disease, we should endeavor so to order the patient's life as to avoid their further action if possible. The clothing of the patient should be carefully attended to, as was indicated before. If his means and circumstances permit, change of climate may be advisable, but it is unwise to counsel such a radical measure until a proper trial has been made of other means. The occupation of the patient may act as either a direct cause of the disease or as a decided barrier to improvement, and should be abandoned temporarily or permanently, partly or wholly, according to its influence in regard to the disease.

Dietetic Treatment.

First in importance in the matter of treatment of the disease when already present must be placed the proper regulation of the diet, by which alone a practical cure may frequently be effected, and without which all known remedies may be used in vain. The general principle by which we are guided in arranging a dietary for the diabetic is that the symptoms are produced by, and that the danger exists in the presence of, an excessive quantity of glucose in the blood and tissues. Such being the case, the manifest indication is to reduce to the lowest possible amount, consistent with the due maintenance of life and performance of function, the ingestion of food capable of being converted into glucose. Such food is comprised in the class of carbohydrates.

In treating a patient with actual glycosuria or glycohæmia of such severity that general and grave symptoms are superadded, it is necessary to keep clearly in mind several facts. In the first place, it must be remembered that for the maintenance of life and for the due performance of the vital functions the food must be taken in such proportions as to furnish sufficient nitrogenous material for the construction of tissue and production of force, and sufficient carbohydrate material for the maintenance of heat. In order to obtain these results the amount of each class is normally so ingested as to furnish at the same time

sufficient material for the needs of the economy without an undue bulk of pabulum. The consumer of almost purely nitrogenous food requires a certain amount of carbon, in obtaining which he must consume much more proteid food than can be needed or disposed of by his organism. This is one reason why the proper arrangement of the dietary for a diabetic is fraught with so much difficulty, avoiding, on the one hand, surcharging the system with nitrogenous waste and depriving it of carbohydrate material, and, on the other, allowing the ingestion of material incapable of being elaborated and assimilated in even proper quantity.

Hard-and-fast rules cannot be laid down as applicable to all cases, and the proper adaptation of dietetic and medicinal treatment to each individual is of prime importance. For example, chronic nephritis is a frequent complication of diabetes mellitus; and it is important, when such complication is present, to be guided by the character of each individual case as to the necessity for increasing or decreasing the severity of adherence to the diabetic diet, avoiding the Scylla of glycohæmia and the Charybdis of uræmic intoxication. This difficulty is not alone a source of embarrassment in the dietetic management of diabetes. The long-continued use of a purely nitrogenous diet is apt to set up or increase the digestive disturbances to the occurrence of which these cases are liable. In addition, it must be remembered that in order that life may continue a certain amount of carbon must be appropriated by the tissue-elements and must be burnt up to afford heat. If this material be supplied in insufficient quantity, not only may the proteids ingested be converted into glucose or its analogues, but the body may, so to speak, consume its own carbohydrate material. Here, again, we must avoid adhering blindly to rule, and must study each individual case by itself in order to determine the capacity for ingestion and assimilation and the amount of carbon required by the organism. It is chiefly for this reason that frequent and careful weighings are absolutely essential to the proper appreciation of the limit to which we can carry out our ideal and theoretically sound antidiabetic dietary.

A further source of embarrassment in this connection is the extreme longing for *wheat* bread or its equivalent experienced by patients from whom it is withheld. This yearning for the "staff of life" is such that oftentimes the patient will resort to strategy to obtain it, as would the opium habitué seek to procure his morphine. These difficulties may be met, and partially at least overcome, by care and watchfulness. The deficiency of carbon ingestion may be largely compensated by increase in the employment of hydrocarbonaceous food, which is incapable of being converted to any great extent into glucose. It is for this reason that the fats should enter largely into the diet of these

patients. This substitution is not a complete compensation, but answers the purpose to a large extent. When the question lies between the risk of increasing the ill effects of a nitrogenous diet in nephritis and that of affording material for the formation of glucose, a compromise must be effected and a balance sought in order to avoid as far as possible both dangers, and, disregarding the amount of sugar in the urine *per se*, we should seek to decrease the amount of nitrogenous food, increasing the allowance of carbohydrate material to a point compatible with safety, although possibly sufficient to cause overflow in the urine. Fortunately, we have in milk, as will be more distinctly seen later, a food that is perfectly suited to the renal condition, while containing carbohydrate material in small amount. The occurrence of intestinal derangement, due as a rule to fermentation and putrescent changes, can usually be controlled by medicinal agents, although frequent variations in the articles of diet allowed must be made to subdue it completely. Loss of weight, if very marked and if associated with glycosuria in spite of the non-ingestion of carbohydrates and in the absence of other distinct cause, may indicate to us the necessity of supplying carbohydrate food from without, instead of permitting the consumption of the tissues of the body itself. Dujardin-Beaumetz believes that if there be great enfeeblement the diet should be less restricted so long as sugar remains below ten grammes per day.

Although there is a uniformity of opinion regarding the broad general rules for the dietetic management of diabetes, there are numerous questions of detail that are still under dispute. All authorities agree in forbidding such articles of diet as belong distinctly to the carbohydrate class. In the matter of latitude in selecting suitable articles of diet and appropriate dietaries we meet with all grades, from that of Cantani to diets but little varied from those of health. The authority mentioned above advises almost complete abstinence from any but a meat diet, and states that patients may live for years upon such articles, finally attaining not only complete recovery, but even acquiring the ability to ingest starchy foods with impunity. This absolute diet of meats has been found not only difficult to enforce, but entirely unsuited to many cases, while in the attempt so to limit the patient we usually produce such a feeling of loathing for the permitted food that he either ceases to ingest sufficient for his needs or else breaks all bounds and refuses to submit, or obtains by stealth articles that are most injurious. Cantani even goes so far as to exclude butter, for the reason that it contains traces of milk-sugar. Such a regimen cannot but be irksome, and in the vast majority, if not all cases, will be found unnecessary. It must be remembered that we are bound to respect the comfort of our patients to as great an extent as is compatible with the effort to prolong life or to produce a cure.

It will usually be found better to wean the patient gradually from his customary diet, first cutting off the most seriously offending articles, until, by repeated examinations of the urine, it is found that all of the carbohydrate food ingested is stored up or consumed by the organism. In this way we not only accomplish, as rapidly and completely as we may wish, the withdrawal of the proscribed articles to the extent necessary for the individual, but we also are much more apt to obtain from him the hearty co-operation so necessary for the proper fulfilment of our plan of treatment. By this means, too, the digestive organs may possibly be enabled to withstand the change of food better than if the whole diet were immediately revolutionized.

Below are considered the articles of diet whose use is almost, if not quite, universally conceded as innocuous. The consideration of those articles that are still in dispute will be discussed more in detail later. Even in those now given there are articles the use of which is permitted by some, and others are omitted that are stated by the majority of observers to be well borne.

Of meats and animal food we may employ all kinds, including cheese, fish, and eggs, the only exception being liver. These, as also all other articles, must be cooked without any carbohydrate addition. The following vegetables are permissible: cabbage, lettuce, spinach, cauliflower, artichokes, cress, endives, broccoli, Brussels sprouts, turnip-tops, sea-kale, and vegetable marrow. Some of these contain a small amount of starch, that can be practically entirely removed by long boiling in a large bulk of water. As relishes, besides the articles mentioned, we permit olives and nuts of all kinds, excepting chestnuts. In the matter of beverages we may allow the use of soda and other alkaline or carbonated waters, while plain water may be taken *ad libitum*. This gives, in brief, the articles of diet that are permitted by most authorities.

Besides these there are many other foods and beverages that are permitted by some, by others tabooed. It seems strange that there should not be more uniformity of opinion regarding a matter that can be so easily verified by a most simple chemical investigation, but there is much dispute concerning the free use or total elimination of certain articles. In order that the various opinions regarding these debated articles may be fully considered, all of them have been excluded from the foregoing list.

Milk, Buttermilk, and Koumyss.—The percentage of milk-sugar, according to Letheby (quoted by Pavy), in cow's milk is 5.2 out of 14 per cent. of solid matter. This, of course, is a relatively large amount of a material at all events closely allied to glucose. Sénator says that sugar of milk has no effect upon the excretion of sugar, and Tyson

makes the statement that sugar of milk resists conversion into glucose more than do other sugars or starchy foods.

Aside also from theoretical considerations, there is great diversity in the results obtained by different observers in the cases in which milk was permitted. The absolute skim-milk treatment of diabetes, first recommended by Scott Donkin, has in the hands of some men given excellent results, while others report but poor success or absolute damage from its use. These divers opinions can only be reconciled by believing that they may depend upon the fact that the cases have had different origins. This "skim-milk cure" is now recommended by but a few physicians, prominent among whom is Tyson, who firmly upholds its value and claims first place for it in the management of diabetes. The method of administration recommended by the latter authority is to give to adults eight fluidounces every two hours between 7 A. M. and 7 P. M., larger quantities being permitted if necessary. He also recommends the separate administration of the curds and the whey if the bulk be inconveniently great in the usual form. Donkin recommended the administration of from four to six pints, increasing slowly and gradually to twelve pints, in twenty-four hours. Skimmed milk is easier of digestion than "whole" milk, but some individuals cannot take even the former without gastric disturbance. In such cases recourse may be had to pancreatized milk. It would appear that idiosyncrasy has much to do with the ability to pursue this course of diet, as certainly many can take milk without increasing the amount of glucose excreted, while in others the strict limitation of diet is not followed by a corresponding decrease of symptoms. Külz, as quoted by Bauer, states as the result of his experiments that milk-sugar is well borne by some, by others poorly borne. Milk is included among the list of permissible articles by Sénator, Fothergill, and Bauer, although in but limited quantity. Dujardin-Beaumetz disapproves of it, while Flint absolutely prohibits its use. In the present state of our knowledge it would seem, therefore, that milk should be placed among the articles of diet to be looked upon with suspicion, and to be tentatively prohibited if there be the least reason to believe that there is an amount of sugar excreted in excess of the carbohydrates ingested with the other articles of diet. If, on the other hand, there are structural alterations in the kidneys that would contraindicate the ingestion of a highly nitrogenized diet, milk is the one article by means of which we may effect a compromise between uræmia and glycohæmia. In such cases there can be no question of the utility of milk, either as an adjunct to or as the main stay of the diet.

Buttermilk is so closely allied to the preceding article of food that it might seem to stand in precisely the same relation to the dietary, but for the fact that it contains less fatty matter and that in it the milk-

sugar is broken up into lactic acid. The former fact takes away some of its value as compared with unchurned milk or cream, unless the suggestion of Fothergill be followed, that it should contain numerous flakes of butter. The conversion of its milk-sugar into lactic acid is a distinct advantage possessed by buttermilk over skimmed milk. In the analysis of buttermilk given by Pavy there is seen to be a slight increase ($\frac{1}{10}$ per cent.) of nitrogenous matter, a marked decrease ($1\frac{1}{10}$ per cent.) of fatty matter, and an increase of 1 per cent. of lactine (*sic*) as compared with skimmed milk. That at least some of the milk-sugar, however, is converted into lactic acid cannot be doubted.

Koumyss, or fermented mare's milk, possesses the same advantage as buttermilk, although even to a greater extent, owing to the mode of preparation by which the milk-sugar is converted into alcohol. The older the article the more complete is this transformation, and the better is it adapted for use in diabetes.

Bread.—The insatiable longing for bread experienced by all from whom it is withheld offers one of the most difficult obstacles in selecting a dietary to suit the patient's fancy. If bread be allowed, much deprivation in other directions can be tolerated, and owing to this fact numerous attempts have been made to obtain some less harmful substitute. These endeavors have, however, to a great extent failed, although the substituted articles are largely used.

Gluten bread is the most universally used of any of these materials. If it were possible to remove from the grain all starchy material, we should still be met by the fact that bread made from such a flour can in no wise be said to take the place of wheat bread in so far as the taste of the patient is concerned. As a matter of fact, there is no such thing, so far as my knowledge goes, as a flour entirely free from starch. In not one of numerous examinations of gluten flour or of articles made therefrom have I found a specimen that did not contain not only a trace, but a large amount, of starch. This can readily be determined by shaking with boiling water a small pinch of the flour that it is proposed to use, allowing it to cool, and then adding a drop or two of a watery solution of iodine and iodide of potassium (the fluid known by the name of Gram, used in bacteriological work, answers the purpose admirably), when if starch be present a distinct blue coloration will be produced. It is important that the test be made after the solution has cooled, or the iodine may be volatilized and the color appear but slightly and transiently. In recommending the use of gluten flour in any form the practitioner should apply this simple test as to the presence of starch. Bauer states that gluten flour is never free from starch, while Dujardin-Beaumetz affirms that many kinds of gluten bread contain as much starch as ordinary white bread. According to the analyses of Dr. Harrington, quoted by Purdy, one of the most fre-

quently used brands of gluten flour contained 66.18 per cent. of starch, while bread made from this flour would contain 35 per cent. of that material. The percentage composition of other brands are stated by this author to contain from 62.94 per cent. to 71.42 per cent. of starch. Now, according to the analysis of Dr. Harrington, wheat bread contains but 44.99 per cent., and Letheby's analysis gives 51 per cent. of carbohydrates. It is very evident, therefore, that by but slightly diminishing the usual amount of ordinary bread ingested we may ensure a smaller consumption of carbohydrates than by allowing the patient to use freely these so-called antidiabetic food-stuffs. Should starch be present in the brand of flour selected, the question would then come up as to the relative amount of starch ingested under the use of gluten bread in unrestricted amounts, compared to the amount when ordinary wheat bread is allowed in a quantity so limited as merely to satisfy to some extent the longings of the patient. It is undoubtedly the case that many a physician, thinking his whole duty performed when gluten bread was ordered and more well-known starchy foods prohibited, has been surprised and discouraged by the persistence of glycosuria in a marked degree.

Should gluten flour be employed these recipes may be followed for its preparation:

To make gluten porridge, stir the flour into boiling water until it has reached the proper consistence, and continue boiling for a quarter of an hour; add salt and butter to taste and eat with milk or cream.

To make gluten bread, take one quart of sweet milk or milk and water, one heaping tea-spoonful of good butter, one-fifth of a cake of compressed yeast beaten up with a little water, and two eggs well beaten. Stir in the gluten flour until a soft dough is formed, knead as in making ordinary bread, put in pans to raise, and when light bake in a hot oven.

Other methods of preparations may be employed to suit the fancy of the patient. The difficulty in pannification of gluten and other flours may be largely obviated by employing the method now frequently used in making the so-called aërated bread.

Besides gluten, other materials have been employed in the endeavor to obtain a substitute for ordinary bread made from wheat flour. Lichenin or moss starch, the principal constituent of Iceland moss, has been proposed, care being taken to remove all of the bitter principle by washing. This, however, is difficult to obtain, and by no means satisfies the desire of the patient.

Inulin, obtained from the root of *Inula helenium*, or elecampane, has been used according to the following formula: 50 grammes (1½ ounces) of inulin are to be put in a large porcelain basin, and, while standing over a water-bath, to be rubbed up with 30 c.c. (1 ounce) of milk and

as much hot water as may be necessary to form it into a uniform dough, to which the yolks of four eggs are to be added, having first been beaten into a foam, and carefully worked in. The dough is finally to be baked in tin moulds previously smeared with butter. The taste of the biscuits may be improved by the addition of vanilla or other spice.

Almond flour has been highly recommended by Pavy, who quotes Boullay's table of its composition, giving 6.0 per cent. as the quantity of carbohydrate material contained therein. Seegen has given the following directions for preparing bread from it: Take of blanched sweet almonds a quarter of a pound. Beat them as fine as possible in a stone mortar, remove the sugar by putting in a linen bag and steeping for a quarter of an hour in boiling water acidulated with vinegar; mix this paste thoroughly with 3 ounces of butter and two eggs. Add the yolks of three eggs and a little salt, and stir well for some time. Whip up the whites of three eggs and stir in. Put the dough thus obtained into greased moulds and dry by a slow fire.

The meal obtained from the fruit of the *Glycina hispida* of China and Japan has been recommended by Lecerf. This meal is stated to be richer in nitrogenous material than animal flesh, and to contain but a small quantity of starchy or saccharine principles. It is practically never used in this country. It contains a purgative oil, and is said to possess a strong and peculiar taste.

All of these substitutes are necessarily unsatisfactory to the patient, and we must fall back upon the breadstuffs more ordinarily employed. In a large proportion of cases it is not necessary to prohibit entirely all bread if the amount be carefully regulated to suit the individual case, while numerous methods of eliminating the more serious risks from its ingestion or of diminishing the amount ingested and desired by the patient may be tried. Bran bread is frequently recommended, but owing to its irritant properties may give rise to diarrhœa, while it contains a large percentage of starch. If, however, constipation exists or there be no tendency to diarrhœa, biscuits may be made according to the following formula, recommended by Camplin: Take one quart of wheat bran and boil in two successive waters for fifteen minutes, straining the mixture through a sieve until the water comes through clear; after each washing squeeze in a cloth until perfectly dry; spread thinly on a dish and place in a slow oven. If put in at night, let it remain in until morning, when, if dry and crisp, it is fit for grinding. The mass so obtained must be ground in a fine mill and sifted through a wire sieve so fine that a brush will be required to push the flour through. Grind again that which remains on the sieve until quite soft and fine. Take 3 ounces of this powder, three new-laid eggs, $1\frac{1}{2}$ to 2 ounces of butter and about half a pint of milk. Mix the eggs

with a little of the milk, and warm the butter with the other portion. Stir the whole well together, adding a little nutmeg and ginger or other spices. Bake in small well-buttered tins in a rather quick oven for about half an hour. Make cakes a little thicker than a captain's biscuit. Sir William Roberts uses seven eggs instead of three, and adds a tea-spoonful of sodium bicarbonate.

Various means may be adopted for rendering the ordinary white bread less harmful to the diabetic. The patient may be instructed to eat the crust alone. By this means we not only furnish the patient with the less tempting part of the bread, but we also restrict him in its use, from the fact that the crust is more difficult to chew and is less freely partaken of, owing to the tenderness of the gums and decay of the teeth frequently found among diabetics. Liebig suggested treating thin slices of ordinary bread with an infusion of malt, by this means converting the starch into sugar, which again is readily removed by washing. The result, however, must be far from palatable. "Torrefied bread" may be used—ordinary bread toasted in thin slices until it is almost blackened.

Dujardin-Beaumetz has even recommended potatoes as better than gluten bread for the use of diabetics. He bases his recommendation upon the fact that the best gluten bread contains 20 to 30 per cent. of starch, while potatoes contain but 8.30 per cent. of saccharifiable material. One hundred grammes of gluten bread are required for two meals, and if we limit the patient to one baked or boiled potato (weighing on an average 100 grammes), we cause less carbohydrate to be ingested, although satisfying the patient's taste fully as well as by the prepared flour.

It has been proposed to employ "wheat germs," which, like other immature vegetable seeds, contain less starch than the mature grain. I know of no complete observations upon their value, but as they contain a purgative oil, they are apt to produce or aggravate diarrhœa if taken in any but very limited quantity.

William A. Hammond states that buckwheat may be ingested in considerable quantity without increasing the amount of sugar in the urine of diabetics. This is the only observation that I know of in regard to the use of this article of diet in diabetes, but as Payen's analysis gives 64.90, and that of Atwater 77.6, per cent. of "starch, etc.," and as I have found very pronounced reaction with the iodine test, it would require close investigation to assure me of the correctness of the statement. Shellfish, with the exception of oysters (owing to the large relative proportion of glycogen), are allowed by all authorities. Tyson does not exclude either clams or oysters.

The following fruits may be permitted: gooseberries, apples, red currants, and cherries, which contain more levulose than grape-sugar.

Tyson also admits cranberries, plums, and strawberries. Of course none of these should be prepared or eaten with sugar, but they may be made more palatable by cooking them with bicarbonate of sodium or potassium.

Coffee and tea are, as a rule, permitted, although a few writers expunge them from their diet-lists. The carbohydrate material in them in the quantities usually employed is so small as compared with their stimulating properties that it would be useless rigor to exclude them. According to Payen's analysis, there is in coffee but 15.5 per cent. of "glucose, dextrin, and undetermined vegetable acid." Cacao-shells may be used in the form of a decoction, but cacao-kernels or chocolate must be omitted from the list, owing to the fact that these contain too large an amount of starch and sugar in the quantities used.

Fats and fatty foods should enter largely into the diabetic dietary, as they assist in furnishing the proper amount of carbon to the organism without being readily converted into glucose. Sénator, however, rejects them in some cases, owing to their contained glycerin.

All articles containing starch, cane-sugar, or glucose must be excluded for obvious reasons. To take the place of sugar for culinary purposes glycerin and honey have been recommended. The former has the great disadvantage that its use is extremely apt to cause serious intestinal disturbance. Two or three ounces have been given in a day, but its administration must be carefully watched. Honey is said by Waldham to have no effect in increasing the amount of sugar excreted, but it would be hardly safe to employ it except in minute quantity and with careful watch kept upon the quantity of sugar in the urine. Fortunately, we have lately had furnished in saccharin a most valuable agent that is perfectly harmless while having three hundred times the sweetening power of cane-sugar. It is a crystalline substance derived from coal-tar, sparingly soluble in cold, but more so in hot, water. It is readily soluble in glycerin, and can be so used, or it can be made up into pastilles according to the following formula:

℞. Saccharin., gr. xlv;
Sodii carbonatis sicc., ʒss;
Manniti, ʒxiiss.
Make 100 pastilles.

One of these pastilles is sufficient to sweeten a cup of tea or coffee. It is best at first not to exceed the use of a grain and a half a day, owing to the fact that in large quantities it may produce gastric pains.

In regard to the use of alcoholic beverages it is necessary to be very strict. Claret, hock, and moselle diluted with water may be allowed

with meals. Sweet wines and those with a *bouquet* must be avoided, especially champagnes, cider, whiskey, brandy, or rum.

No better guide can be furnished for the proper construction of a diet-list for the diabetic than by quoting *verbatim* that given by Austin Flint, Jr., in his paper upon the treatment of diabetes, read before the American Medical Association at the meeting of May, 1884, and published in the journal of that association, July 12, 1884. It reads as follows:

"*Breakfast.*—Oysters stewed, without milk or flour; clams stewed, without milk or flour; beefsteak, beefsteak with fried onions; chicken; mutton or lamb chops; kidneys, broiled, stewed, or devilled; tripe, pig's feet, game, ham, bacon; devilled turkey or chicken; sausage, corned beef; hash without potatoes; minced beef, turkey, chicken, or game, with poached eggs; all kinds of fish, fish-roe, fish-balls without potatoes; eggs cooked in any way, except with flour or sugar; scrambled eggs with chipped smoked beef; picked salt codfish with eggs; omelettes plain or with ham, with smoked beef, kidneys, asparagus-points, fine herbs, parsley, truffles, or mushrooms; radishes, cucumbers, water-cresses, butter, pot-cheese; tea or coffee, with a little cream and no sugar; light red wine for those who are in the habit of taking wine at breakfast.

"*Lunch or Tea.*—Oysters or clams, cooked in any way except with flour and milk; chicken, lobster, or any kind of salad except potato; fish of all kinds; chops, steaks; ham, tongue, eggs, crabs, or any kind of meat; head cheese; red wine, dry sherry, or Bass's ale.

"*Dinner.*—Raw oysters, raw clams; soups *consommé* of beef, of veal, of chicken, or of turtle; *consommé* with asparagus-points; *consommé* with okra, ox-tail, turtle, terrapin, oysters, or clams, without flour or milk; chowder, without milk or potatoes; mock turtle, mullagatawny, tomato; gumbo filet; all kinds of fish; lobsters, oysters, clams, terrapin, shrimps, crawfish, hard-shell crabs, soft-shell crabs (no sauces containing flour or milk); pickles, radishes, celery, sardines, anchovies, olives; all kinds of meat, cooked in any way except with flour; all kinds of poultry, without dressings containing bread or flour; calf's head, kidneys, lamb-fries, ham, tongue; all kinds of game; veal, fowl, sweetbreads, etc., with currie, but not thickened with flour (no liver); truffles, lettuce, romaine, chiccory, endive, cucumbers, spinach, sorrel, beet-tops, cauliflower, cabbage, Brussels sprouts, dandelions, tomatoes, radishes, oyster-plant, onions, string-beans, water-cresses, asparagus, artichokes, Jerusalem artichokes, parsley, mushrooms; all kinds of herbs.

"*Substitutes for Sweets.*—Peaches, preserved in brandy, without sugar; wine-jelly, without sugar; *gelée au kirsch*, without sugar; *omelette au rhum*, without sugar; *omelette à la vanille*, without sugar; *gelée au*

café, without sugar. Butter, cheese of all kinds; almonds, hazelnuts, walnuts, cocoanuts; tea or coffee, with a little cream and without sugar."

When some concessions must be made in the matter of carbohydrate food, whether owing to disgust of the patient for his diet or to actual loss of weight, it is necessary gradually to add those articles that can produce the least harm from the presence of a carbohydrate in them. In order to aid somewhat in choosing such articles, the following list of food-stuffs, with their percentage of carbohydrate material, is appended. From these may be selected progressively the food that will answer our purpose, choosing, other things being equal, those containing the least amount of the objectionable constituent:[1]

Wheat bread	55.5	Potatoes	21.3
Wheat flour	75.6	Sweet potatoes	21.1
Graham flour	71.8	Turnips	6.9
Rye flour	78.7	Carrots	10.1
Buckwheat flour	77.6	Cabbage	6.2
Beans	57.4	Melons	2.5
Oatmeal	68.1	Apples	14.3
Corn meal	71.0	Pears	16.3
Rice	79.4	Bananas	23.3
Sugar	96.7		

(According to Professor W. O. Atwater.)

Exercise.—The amount of bodily exercise to be indulged in by diabetics requires careful attention. Exercise, increasing as it does the power of metabolism, is very beneficial in the disease under consideration, but it must be remembered that there is a vast difference between physical exercise and physical exhaustion. The former is of distinct advantage, while the latter acts badly, not only as in other diseases, but because it is especially apt to be the precursor, if not the immediate exciting cause, of diabetic coma. Forms of exercise should be chosen that combine with them some amount of pleasure. For the rich, mountain-walks or horseback-riding are probably the most efficient, while for those whose means are too limited to indulge in the expense of a trip to the mountains or the keeping of a horse other almost equally good means of reaching the same end may suggest themselves. Dujardin-Beaumetz highly praises joinery as combining enjoyment with exercise. Floriculture, also, has the advantage of inducing the patient to take a moderate amount of exercise without the sense of compulsion that is felt to be exerted when a "constitutional" walk or some other routine form of exercise is insisted upon.

Climate.—The question of the necessity for a change of climate is one requiring careful consideration in all diseased conditions. This is true in diabetes, not only on account of the expense, which is at times great, and of the breaking up of all business engagements and social

[1] Further diabetic dietaries will be found in Dr. Yeo's article, page 667.

ties, but also from the fact that away from his own home there may be great difficulty in obtaining for the patient the proper articles of diet. It must also be borne in mind that the fatigue incident to a long journey may be of distinct and permanent disadvantage. The equable climate of moderate or low elevation, with a mean temperature of from 65° to 75° F., should be chosen, while the place of abode should also be considered as regards the surroundings of the patient and the facility for proper exercise. In view of the above-mentioned difficulty in procuring allowable articles of diet and of having them properly prepared, as well as on account of the more general reasons stated, all other means of combating the disease should be faithfully tried before advising such a radical change as removal from home. Of course if phthisis pulmonalis should develop, change of climate may be necessary. In that case the same rules as to choice should be followed as though the secondary disease existed by itself.

Medicinal Treatment.

The medicinal treatment of diabetes is far from satisfactory, and necessarily so, since we know so little of the pathology of the disease. It is to be remembered that in the present state of our knowledge the dietetic treatment is far more important than any medicinal treatment, and that without the former the latter is practically valueless. If, however, we can in any way by means of drugs increase the power of the organism to digest, absorb, and assimilate carbohydrate food, and so diminish the amount of dietary restriction necessary, we shall do much to increase the comfort and well-being of our patients, even though direct cure by drugs alone may be impossible. The unnecessary use of drugs is strongly to be deprecated, and none should be employed unless found, after a fair trial, to be of absolute benefit to the patient. It is better upon assuming charge of a case of diabetes at first, to gauge the patient by making careful quantitative tests for sugar (by the fermentation method or by means of Fehling's solution) for twenty-four or forty-eight hours while the patient is taking his ordinary diet. By this means we can determine quite exactly the amount of benefit that we are conferring as the articles of diet are gradually reduced. The diet then being gradually restricted, further quantitative tests should be made before the medicinal treatment is instituted, as otherwise we may continue the use of a drug when the restricted diet alone is causing the improvement. This preliminary testing may be tedious to the physician and unsatisfactory to the patient, but will repay the trouble taken, and will usually be gracefully accepted by the sufferer if the reason for it is properly explained or if some harmless placebo be given.

It must be remembered that our patient may not only be suffering

from the effects of glycohæmia, but that very frequently there are other minor conditions attention to which might be of far more value than would the attempt to place the patient immediately upon a course of medicinal treatment in the hope of directly influencing the amount of glycosuria. The disorders of the digestive system previously hinted at should receive prompt and careful attention, particularly as we are soon to subject all of the organs of digestion, absorption, and assimilation to an unaccustomed amount of work in elaborating a large quantity of nitrogenous food. It has never been my fortune, so far as I am aware, to examine the urine of a case whose diet had not already been limited to such food; but in the sediment of every saccharine urine that I have examined there have been large numbers of oxalate-of-lime or uric-acid crystals, either separate or in combination. This concurrence of crystals, indicating imperfect elaboration of a largely nitrogenous diet, is not to be wondered at, but should such crystals be found, evidently not as a result of the dietary abnormalities, their presence would indicate the necessity for careful treatment of the various organs whose functions will be so strained during the alteration in diet.

Having by medicinal means prepared the digestive tract as far as possible, and having ascertained the amount of influence exerted by diet alone, we shall have to determine in the first place whether drugs can assist us at all, and if so, what course of treatment shall be adopted. In this connection too much attention cannot be paid to the family and past personal history of the patient as aiding us in determining the possible etiological factors in the particular case in hand, and so help us to select a rational method of applying our remedies.

The drug probably most frequently employed in attempting to effect an amelioration of the symptoms or to produce cure of the disease is opium, including its alkaloids, morphine and codeine. On the question of its utility authors are divided, some believing it to be the best drug at our command, while others absolutely condemn it. That the drug in some cases may assist careful dieting in banishing the disease or holding it in check cannot be doubted in the face of the results announced by good authorities. How it acts in these cases it is impossible to state positively, although numerous attempts have been made to explain its mode of operation by means of its influence upon the vaso-motor nervous system. In regard also to the choice of the preparation to be used there is great difference of opinion. Strümpell considers that opium is the best agent to use in diabetes, and that its alkaloids are of less value than the drug itself. He gives it to the amount of four, eight, or even more grains in twenty-four hours. Pavy believes nothing is so good as opium, morphine, and codeine. He at once places a patient of forty-five or fifty years of age on small

doses of one of the three, and gradually increases the dose. He finds that the sugar diminishes and usually disappears. Tyson places codeine first among drugs, giving it in pill or solution in doses of one-quarter of a grain three times a day, increasing a quarter of a grain daily until sugar disappears, the remedy ceases to act, or drowsiness is produced. He has given as much as forty-seven grains a day. Tyson thinks opium and morphine less efficient, more dangerous, and more apt to produce troublesome constipation than codeine. He states that he has never seen total recovery under its use. Shattuck gives opium in divided doses or in one dose at bedtime. If the latter plan be adopted, he advises the administration of one grain, increased gradually until the sugar either disappears or ceases to diminish in quantity. H. C. Wood says that opium "is of very great value in many cases, often ameliorating the symptoms, and, in conjunction with restricted diet, sometimes even effecting a cure. Of course, however, like all other known remedies in this disease, it most frequently acts simply as a palliative." Sénator advocates the use of opium only now and then during the course of a case, especially at such times as the patient becomes tired of meat diet and has to return to miscellaneous food. On the other hand, Flint never gives opium except for the relief of pain. Roberts states that opium in doses of from six to twenty grains a day has always, in his experience, reduced the quantity of the urine by about one-half, without reducing its specific gravity, when no restriction was placed on the diet. It does not, he says, arrest the disease, and when given to patients upon restricted diet does not lessen either the amount of urine or the sugar excreted. He believes that when the diet is not restricted opium acts entirely by diminishing the appetite.

The position of opium in this disease is therefore still unsettled. As will be mentioned again, the drug would seem to be of decided value in combating the complication of gangrene. As in other diseases, the rule should be carefully borne in mind here that the occurrence of nephritis is either a signal for great care in, or actual cessation of, the use of opium and its derivatives.

Ergot was formerly much used, but has not maintained its position of late years. Its action in reducing the amount of urine excreted in diabetes insipidus probably led to the hope of benefit from it in saccharine diabetes, in which, however, the polyuria is in all probability the effect of glycohæmia rather than of any renal vaso-motor change.

When we consider the frequent association of the gouty diathesis and diabetes mellitus, it is not to be wondered at that treatment by various forms of alkalies should be of benefit. Such undoubtedly is the case. Foremost in the rank of remedies of this class stand the various alkaline waters. The Mecca of the gouty, Carlsbad, has long

been celebrated as a resort for those suffering from diabetes mellitus, and the results there obtained have surely not been by any means altogether dependent upon the accessory conditions of living insisted upon at that place. A residence at Vichy or Vals has also been of great advantage in treatment. In our own country the Poland, Waukesha, Bethesda, and Saratoga waters may be employed at home or the patient may take a course of treatment at the springs. The part played by such treatment in ameliorating the condition is by no means a small one, and the waters can be readily employed without either secondary evil consequences or interference with other plans of medication, while they offer a ready vehicle for the administration of other remedies.

A method of treatment that has attained a high place is that introduced by Martineau and commonly called by his name. As recommended by the originator the plan adopted was as follows: Into such an apparatus as is used in Paris for the extemporaneous manufacture of carbonated water there are placed 20 centigrammes of lithium carbonate and half a fluidounce of a solution consisting of 20 centigrammes of arseniate of sodium in 500 grammes of distilled water. About a litre of carbonic-acid water is used. This amount is to be drunk daily, either by itself or mixed with wine at meals. (The English equivalents for the above quantities are 3 grains of lithium carbonate, $\frac{1}{10}$ of a grain of sodium arseniate, and 2 pints of carbonic-acid water.) Practically, there is found to be no necessity for such an elaborate method of preparation, the simple addition of from 5 to 10 grains of lithium carbonate, and of either 2 drops of Fowler's solution of arsenic or of from $\frac{1}{50}$ to $\frac{1}{30}$ of a grain of sodium arseniate to a tumblerful of an effervescing alkaline mineral water, answering every purpose. Tyson advises the use of ordinary drinking-water instead of the carbonic-acid water recommended by Martineau. As, however, this method of treatment is particularly applicable to those cases having a close or remote connection with gout, it is advisable to use the alkaline waters as the vehicle of administration. There is much unanimity of opinion in regard to the fact that the method under consideration is of advantage in this disease, but it has lost some of its former reputation, in part, no doubt, from the fact that too much was anticipated from its use. The general condition, in particular, is much improved thereby, and many of the symptoms of subjective annoyance are diminished. That it, of itself, is able to cure cannot be justly claimed, but in the same category may be placed all other drugs of which trial has been made. The method has certainly a rational foundation theoretically, while in practice sufficiently good results have been obtained to warrant the further pursuance of it.

Arsenic by itself attained great repute at one time, but the combi-

nation of it with other remedies has practically entirely superseded the simpler method of administration. The bromide of arsenic, in the form usually known as Clemens' solution, has been used by many with good effect. This solution, when made according to the formula given in the United States Dispensatory, contains in each minim one forty-eighth of a grain of the arsenic salt. The commencing dose is one minim three times daily, to be gradually increased until from three to five minims are taken after meals. Good results are reported in this country by Flint, Tyson, and Shattuck, although their patients seem to have been as much indebted to the dietary restrictions as to the remedy, if not more so. Flint found especially that the remedy exerted control over the amount of thirst and polyuria, while at the same time the amount of sugar excreted was diminished. The remedy should be tried in all cases in which there is a suspicion of a neurotic causative factor combined with indications for the use of the alterative.

The bromide of potassium has been highly praised, but is now seldom used. The indication for its use should be perfectly clear and decided before we run the risk of provoking the gastro-intestinal disturbance so apt to follow its employment. Knowing its depressing effect, it should not be given unless distinctly called for in cases, and they are frequent, in which there are marked languor and both actual and subjective weakness. Begbie and Van Traa have reported some marked successes from its use, and Foster recommends it combined with tincture of chloride of iron. Most observers, however, have obtained but little benefit from this salt. The iodide of potassium has also been used, but has fallen into a possibly undeserved obscurity.

Iodoform was first recommended for diabetics by Moleschott in doses of from a quarter to a half of a grain. The formula used by him for its administration was—

℞. Iodoform., gr. xv;
Ext. lactucarii sativ., gr. xv;
Cumarin, gr. iss.
M. Ft. pil. No. xx.
Dose, one pill three times daily.

It may also be given at bedtime alone in larger doses. It must not be forgotten that there is danger of poisoning from the use of the drug.

Cantani suggested the use of lactic acid in daily doses of from one to two and a half drachms dissolved in half a pint of water. The drug has the great disadvantage of tending to produce gastric distress, diarrhœa, and rheumatoid pains when given in large doses. It cannot be considered as in any degree curative, but, according to Sénator, it is "the only direct substitute for sugar. The excretion of sugar is not in

anywise altered by lactic acid, but the patients get the same advantage from the lactic acid that a healthy person gets from starch and sugar." Practically, the same statement is made by Strümpell. Roberts does not believe at all in the use of the drug. Lactic acid has certainly not maintained its reputation, although still used by some with asserted advantage.

Sénator recommends the use of fatty acids in cases of diabetes that are accompanied by degeneration of the pancreas, but states that when the assimilating power of the liver is at fault they should not be used. He recommends their administration in the form of soap, one hundred and forty grains being made up into sixty pills, of which four or five are to be taken three times daily. Aside from the difficulty of differentiating the cases included in the classes mentioned, it is indeed difficult to see what advantage could be gained from the employment of this plan of medication.

Salicylate of sodium has been employed by some with apparent good effect. It may be given in doses of from sixty to one hundred and fifty grains a day, its administration always being watched, lest the symptoms characteristic of its over-ingestion are manifested. It is well to try the effect of the drug in cases in which there is suspicion of an arthritic origin, although the other plans of treatment already recommended for this class are more apt to produce the desired effect.

Carbolic acid was at one time used in the treatment of this disease, but has fallen into obscurity, and probably without any loss to our patients. The use of the drug has no good theoretical foundation, while the results from its employment have been far from satisfactory. The danger of poisoning by it is great, while its effect upon the function of digestion is apt to be most unfavorable.

Quite recently antipyrine has been highly recommended, and some of the claims for it are accompanied by reports of cases showing marked amelioration under its use. Many of these cases, however, must be eliminated, owing to the fact that some alteration in diet was made coincidently with the administration of the drug and the diminution in the amount of sugar excreted. Leaving out these cases, there are yet a sufficient number of successful results, so far as symptoms and signs are concerned, to warrant us in believing that the drug has some controlling influence over the excretion of glucose in the urine. When we consider the wonderful power of this drug in many neurotic conditions, it is not surprising that such an influence should be exerted upon the cases that in the present state of our knowledge seem to arise in the nervous system. Good effects are reported by Germain Sée, A. Robin, Buchard, and Dujardin-Beaumetz. The latter authority recommends that the drug be given in daily doses of from thirty to forty-five grains; he states that it markedly diminishes the amount of both

the sugar and urine excreted, and considers it as valuable as ergot. Purdy does not consider the drug of much value, and cites cases in which it failed to influence the course of the disease. In these instances, however, dietary rules were relaxed, so that his unfavorable report from these cases is merely such as would be expected under similar conditions in using any of the drugs recommended for the treatment of the disease. The same remarks except as to dose may be applied to the congeners of antipyrine, acetanilid and phenacetin.

Sulphonal has been used in diabetes, as in almost every disease of late, and Caserelli states that by its use he has produced marked diminution in the excretion of both sugar and urine. He cautions us against the use of too large doses, as being apt to produce vertigo and excessive somnolence. The drug may be used with advantage to combat the sleeplessness frequently seen in these cases, but that it possesses anything approaching to a specific influence is not proved.

The influence of oxygen upon the processes of assimilation has naturally led to its employment in this typical disorder of that function. The gas is now so readily obtainable that frequent observations upon its use may be expected. If the reports already published regarding its favorable action should stand the test of further experience, it will be a valuable adjunct to our armamentarium, in that the respiratory organs may be utilized for medication, to the saving of the organs of digestion. The gas can be readily procured already generated and stored in cylinders or gum bags, or can be manufactured as required by one of the many "oxygen generators" at present on the market. The method of administration recommended by Purdy, who reports a reduction of 50 per cent. in the amount of sugar excreted without any change of diet, is the inhalation of from three to five gallons in the morning and afternoon. A further advantage from its use may be its local action upon the respiratory mucous membrane, affections of which are so very common as complications or incidents of the disease.

As a result of his researches upon the relation of the pancreas to diabetes, Lépine tried the use of pilocarpine in cases suffering from this disease, and from the few cases so treated there is reason to believe that as a stimulant to pancreatic activity it may be of decided value in at least some instances. Should we have reason to suspect that a given case had a pancreatic lesion as the *fons et origo* of the symptom of glycosuria, or should further researches enable us to differentiate with certainty true pancreatic diabetes from that due to defective or intensified action of other organs, pilocarpine might prove of inestimable value. The administration of the drug in such cases would be a scientific and rational plan of treatment.

Many other conditions besides those already mentioned require

medicinal treatment, on account of being either annoying to the patient or dangerous to his well-being. One of the most troublesome symptoms is intense thirst. This symptom is dependent upon two conditions—the polyuria excited by the presence of glucose in the blood, and the excretion of sugar in the saliva and other secretions of the mouth, causing an excessively dry sensation therein. It cannot be possible that the ingestion of water, except in quantities sufficient to disturb gastric digestion, can be of any distinct disadvantage, but rather may tend to wash out the abnormal amount of sugar from the tissues, and to a certain extent prevent its harmful influence upon them. It is possible also that the free dilution of the blood by the water ingested may postpone the occurrence of coma. If, however, the amount of water desired be too great for the good of the patient, or if the thirst be so excessive as to interfere with his comfort or prevent sleep, the addition of either a few drops of lemon-juice or the administration of a small quantity of bitartrate of potassium in each tumbler of water may be tried. The employment of cracked ice may cause a less amount of fluid to be ingested, while the simple expedient, so often of use in satisfying the craving of children without allowing much water to be taken, may be resorted to—namely, offering the water in a small glass, the swallowing of which frequently produces the same sense of satisfaction as does a larger amount. A weak mixture of brandy (in small quantity) and water is more satisfying to thirst than is plain water.

A common accompaniment of diabetes is gingivitis, due, as is the dental caries, to the abnormal fermentative changes occurring in the buccal cavity. The liability to this annoying complication demands that the greatest care should be taken in the ordinary daily toilet of the teeth, and in addition renders advisable the use of some germicidal and antiseptic mouth-wash for frequent use during the day. For this purpose listerine will be found of value, or one of the following prescriptions may be used:

℞. Sodii boratis,
Potassii chloratis, *āā*. ʒj;
Glycerini, f℥j;
Mucilaginis acaciæ, f℥ij;
Aquæ, q. s. ad f℥vj.—M.

℞. Acidi borici, ʒvj;
Acidi phenici, gr. xv;
Thymol., gr. iv;
Aquæ, Oij.
M., et adde.

Spiriti anisi,	f℥iiss;
Spiriti menthæ piperitæ,	gtt. x;
Alcoholis,	f℥iij;
Cochineal, sufficient to color.	

To be diluted with as much water before using (Dujardin-Beaumetz).

Should there be much relaxation of the gums the use of tincture of myrrh or of a solution of tannin may also be required.

One of the most distressing subjective symptoms in some cases is a feeling of intense craving for food, with a sense of hollowness and sinking in the epigastric region. This sensation is best relieved by giving, as advised by Roberts, a two- or three-grain pill of asafetida two or three times a day.

Owing to the almost purely nitrogenous character of the diet, there are apt to be frequent attacks of diarrhœa, due to putrefactive and fermentative changes in the intestines. In order to control this, the bowel should be first completely emptied of its irritating contents by means of castor oil or some other simple laxative, and then one of the numerous intestinal antiseptic preparations administered. Of the latter, thymol, salol, β-naphthol, and salicylate of bismuth are as efficient as any others. If the diarrhœa be due to the elimination of sugar from the mucous surface of the bowel, the foregoing treatment will aid in evacuating it before fermentative changes can occur, while at the same time the antiseptics mentioned will further prevent the occurrence of fermentation that may take place later in the sugar that continues to be excreted. In this way we may prevent the occurrence of a true enteritis with its attendant exhaustion.

Another frequent and often excessively annoying symptom is intense itching of the skin. This may be general, as in a case at one time under the writer's observation, in which large quantities of sugar were found in the sweat excited by and reclaimed from a flannel pad placed for the purpose in the axilla, or the itching may be purely local, its usual seat then being in the region of the genitalia, where the annoyance produced by it may be sufficient to overshadow all other symptoms. In the latter class a certain amount of prophylaxis may be employed. Absolute cleanliness of the person is essential, while it will be found that much of the irritation and subsequent inflammation may be avoided by the simple precaution of carrying about the person some absorbent material with which the parts may be thoroughly dried after each act of micturition, so avoiding the leaving of any residue that might undergo fermentative changes. When such irritation has been present and produced its effects, the same rule of cleanliness should be strictly enforced, while in addition to other remedies the neighboring skin should be protected by some soothing inert or slightly stimu-

lating ointment, such as vaseline or the benzoated ointment of oxide of zinc.

The cystitis occasionally seen in diabetes should be treated either by the administration by the mouth of such drugs as have an antifermentative action and are eliminated by the kidneys, or by irrigation of the bladder through the urethra with antiseptic solutions similar to those used in cases of cystitis from other causes.

The neuritis that at times occurs in the course of the disease requires the same treatment as would be employed in a similar condition due to other causes.

As is well known, the subjects of diabetes frequently die from intercurrent pulmonary affections, chiefly from phthisis pulmonalis. The frequency of inflammatory affections of the respiratory tract should make us especially careful in regard to the proper clothing and hygiene of such patients. In spite of the greatest care, however, diabetics, almost without exposure, become attacked by respiratory diseases, in part possibly from the low bodily temperature usually maintained by them, and also from the fact that the lungs are fed by improperly composed blood, and are readily excited to take on inflammatory changes, which are, as a rule, of low grade, giving rise to chronic catarrhal pneumonia with rapid breaking down of tissue. Bearing in mind this tendency, the importance of prophylaxis by proper clothing and other hygienic measures becomes very evident, as also the necessity for maintaining the nourishment of the body, even though it may increase the amount of glycosuria, by relaxing somewhat our dietetic restrictions when we find a progressive loss of weight under a limited dietary. The treatment of such cases must be based upon the same considerations as would guide us in cases not occurring as a complication of this disease.

The appearance of boils and carbuncles is rather a frequent complication. Being local manifestations in the skin and connective tissues of the general malnutrition and of the soaking of the tissues in saccharine fluids, the indications for treatment are precisely those of other concomitants of the disease, but in addition we may use the phosphide of calcium in doses of from a tenth to a half a grain. Surgical interference is called for to remove the already broken-down tissues, just as is the case in other conditions where pus has formed. Cod-liver oil may be used also, being indicated as well by the local manifestations as by the general condition of malnutrition, of which the former is but an outward and visible sign.

Closely allied to the foregoing is another more serious complication, not of rare occurrence, and frequently the complaint that leads to the examination of the urine—namely, gangrene. This may be looked upon as brought about in the same way as are the symptoms last

considered and the chronic lung-changes—namely, by the general condition becoming deteriorated while the tissues are bathed in a blood rich in glucose, resulting in gangrene of those parts farthest removed from the centre of the circulation, and therefore less able to resist the effects of lowered vitality. Should gangrene occur, the question of operative interference would present itself for consideration. There is no difference of opinion regarding the inadvisability of performing any operation upon the subjects of diabetes save under actual necessity. Such being the case, it is evident that where the tendency to gangrene is already manifested the use of the knife should be avoided as much as possible. The usual rule, therefore, in these cases is to attempt to keep the gangrenous parts in as aseptic a condition as possible by means of various antiseptic materials, and to keep them free from odor. The parts that are entirely mortified may be removed by scissors or the knife without interfering with those tissues still possessed of vitality, so reducing the bulk of the gangrenous mass. Upon the formation of a line of separation the dead tissue may be readily removed. While in the case of the extremities the result may not be so good from an æsthetic point of view, allowing Nature to complete the separation is certainly a safer method, and one as sure, although not so rapid, as by the use of the knife. Practically, but little time is gained by a formal amputation, as it is impossible to foretell the extent to which the gangrene will reach until the line of demarcation has formed. Should, however, the local condition of gangrene be evidently affecting the patient's general condition, amputation may be required. Opium is credited with possessing marked power over this as well as other gangrenous processes, and is recommended to be given in large doses. Some writers recommend doses of a grain to a grain and a half or more night and morning.

A much-to-be-dreaded and usually fatal complication, or rather termination, is that of diabetic coma. There would seem to be two varieties of this condition, showing different modes of onset—one in its inception being cerebral, the other intestinal in type. Nothing is definitely known as to what the symptom is immediately dependent upon. A theory formerly looked upon with much favor was that it was the result of acetone in the blood. This is, however, by no means proven. The two theories at present chiefly held are, that it is due to decrease in the alkalinity of the blood, or to the absorption of toxines from the alimentary tract. Here, as in the case of other complications and symptoms of the disease, the first indication is to reduce the amount of glucose in the fluids of the body. Presuming that this has been already accomplished so far as is possible, the symptom must be dealt with by more prompt measures. Schnitz of Neunahr recommends the administration of a table-spoonful of castor oil every hour until a free

evacuation of the bowels has been obtained. Transfusion of blood was urged as a remedy in this condition by Dieulafoy, but the measure has been found to be of practically no advantage, while the dangers and difficulties of the operation are almost of themselves sufficient to cause its abandonment, except possibly in institutions where the apparatus and necessary assistants can be readily procured. Even there, however, the plan is hardly worthy of a trial. Basing the treatment upon the theory of decreased alkalinity of the blood, the intravenous injection of saline solutions has been repeatedly tried. The results so far obtained do not warrant us in believing it to be a measure that can in many instances enable us to save from death patients who have become comatose. The use of such injections has, however, in some cases, apparently been the means of cure, while in others it has been of decided benefit, although not completely successful. Dickinson reports a very interesting case in which he employed the method with apparent benefit. The account is chiefly of interest from the fact that after the injections the patient regained consciousness for a time, and that during thirty-two hours four hundred and fifty-six ounces of fluid were injected. The case, however, terminated fatally. The best site for the operation is the prominent vein upon the instep, the tissue being there easily dissected and the vein readily picked up, while its distance from the heart ensures a more perfect admixture of the solution and the blood-column before they reach the heart and medulla. The solution should be freshly prepared with boiled and filtered water, to which has been added a drachm and a half of sodium chloride and fifteen grains of sodium carbonate to each quart of fluid used. The fluid should be warmed to 100° F., and then injected slowly by means of gravity pressure, the reservoir being held at a height of three feet above the level of the canula. The latter should be of about one-sixteenth inch bore. In Dickinson's case, above mentioned, there were added to the water potassium chloride and the sulphate, phosphate, and carbonate of sodium. Alkalies may also be administered by the mouth, but they are not in this way so rapidly utilized as by intravenous injection. Strümpell recommends the subcutaneous injection of ether or camphor, with lukewarm baths and douching.

To sum up, then, the plan of treatment of diabetes that has been recommended: In the first place, the patient's sugar equation, so to speak, should be gauged by quantitative analyses of the urine before any line of treatment is determined upon. Having found the amount ordinarily passed by the patient, the most manifestly injurious carbohydrates are gradually but steadily prohibited, either until sugar entirely disappears from the urine and the other signs and symptoms of the disease grow less, or else until the patient's diet has been so restricted that he is ingesting

no carbohydrate food. The rigid diet is to be essentially one of proteids and fat. During this time the digestive organs must receive careful attention. Having thus determined the extent to which diet alone is capable of diminishing the amount of glucose excreted with the urine, the use or selection of medicinal remedies must be considered. If a gouty origin be suspected, the drugs likely to be of value are the alkaline waters, the carbonate of lithium (with or without the addition of arsenic), the salicylate of sodium, or alkalies in some other form. If the case be one of a presumably neurotic character, opium, arsenite of bromine, antipyrine or one of its congeners, or bromide of potassium should be tried. Should a pancreatic origin be suspected, jaborandi or pilocarpine may be found of value. Upon the failure of these dietary restrictions and medicinal aids, change of occupation and of climate should be carefully considered. Carefully regulated exercise should be insisted upon, with properly supervised bathing. The clothing worn should be suited to the climate and season of the year. Upon the supervention of any of the complications mentioned the dietary should be carefully examined, and if necessary corrected. Should coma threaten, the patient should be promptly purged with castor-oil and the intravenous injection of an alkaline saline solution practised upon the evident failure of the former method to be efficient. Upon the intervention of nephritis the use of an absolute milk or buttermilk diet may be required. Finally, it must never be forgotten that, as no two cases are precisely alike, each case must be carefully studied and treated accordingly.

INDEX TO VOLUME I.

A.

Abdomen, massage of, 276
Abstracta, 97
Abstracts, 97
Aceta, 87
Acetanilide in acute articular rheumatism, 974
  in diabetes mellitus, 1030
Acetic acid as a disinfectant, 585
Acid, acetic, as a disinfectant, 585
  benzoic, in acute articular rheumatism, 975
    in tuberculosis, 834
  boric, as a disinfectant, 585
    in tuberculosis, 840, 864
  carbolic, in diabetes mellitus, 1029
    as a disinfectant, 590
  chromic, as a disinfectant, 585
  citric, as a disinfectant, 585
  hydrochloric, as a disinfectant, 583
  hydrocyanic, in tuberculosis, 865
  hydrofluoric, in tuberculosis, 880
  lactic, in diabetes mellitus, 1028
    as a disinfectant, 585
  nitric, as a disinfectant, 583
  nitrous, as a disinfectant, 585
  oxalic, as a disinfectant, 585
  phosphoric, as a disinfectant, 585
  salicylic, in acute articular rheumatism, 969
      dose in, 973
      influence on hyperpyrexia, 971
        on pain and joint-inflammation, 969
        in preventing cardiac manifestations, 970
        in preventing relapses, 971
        on pyrexia, 969
      mode of action, 972
        of administration, 973
    as a disinfectant, 585
    untoward effects of, 971
  sulphuric, as a disinfectant, 583
  sulphurous, as a disinfectant, 583
  tannic, as a disinfectant, 585
Acids as disinfectants, 583
  fatty, in diabetes mellitus, 1029
Acidulous waters, 530
Acute gout, 996
    treatment of, internal, 997
      local, 997
  tuberculosis, disseminated, 849
      food in, 852
Acute tuberculosis, disseminated, treatment of, 853
    localized, 856
Air, 386, 389
  baths, hot, 511
  chemic constitution of, in therapeusis, 812
  compressed, continuous respiration of, in tuberculosis, 807
    expiration into, in tuberculosis, 807
    inspiration of, in tuberculosis, 805
  impregnation of, with medicinal agents, in tuberculosis, 821
  moisture of, in pneumotherapy, 810
  rarefied, expiration into, in tuberculosis, 808
    inspiration of, in tuberculosis, 807
  respired, diminution of oxygen in, 813
  temperature of, in pneumotherapy, 810
Albuminates in foods, 626
Albuminuria, food in, 669
Alcohol in gout, 990
Alcoholic beverages in diabetes mellitus, 1021
  solutions, 80
Alimentary principles, 625
Alimentation forcée, 699
Alkalies as disinfectants, 585
Alkaline treatment of acute articular rheumatism, 976
      effect of, in preventing cardiac complications, 976
    of acute gout, 999
  waters, 519
    comparative chart of, 521
    in diabetes mellitus, 1026
Almond flour in diabetes mellitus, 1019
Altitude in climatology, 390
  effect of, on mortality in phthisis, 420
  in the treatment of tuberculosis, 783
Ammonium benzoate in tuberculosis, 840
Anæmia, massage in, 309
  in scrofulosis, 949
Anæmic conditions, food in, 696
Anæsthesia, neurotic, electricity in, 199
Angina pectoris, electricity in, 194
Aniline violet as a disinfectant, 592
Animal foods, 629
Antifebrile agent, wet pack as an, 481
Antipyrine in acute articular rheumatism, 974
  in diabetes mellitus, 1029
Antisepsis, 599
  in abdominal operations, 620

Antisepsis in burns, 624
in genito-urinary diseases, 622
in scalds, 624
in special regions, 620
in urethritis, 622
in urinary diseases, 622
Antiseptic dressings, 610
operation, description of, 607
Anus, fistula of, 914
Apothecaries' measure, 57
weight, 57
Apparatus for pneumotherapy, S. Solis-Cohen's, 796
Aquæ, 73
Aqueous solutions, 73
Arseniate of soda as a disinfectant, 589
Arsenic in diabetes mellitus, 1027
bromide of, in diabetes mellitus, 1028
in gout, 996
in rheumatoid arthritis, 983
in tuberculosis, 845
Arsenical baths in rheumatoid arthritis, 983
Arthritis, chronic gouty, local treatment of, 1000
chronic rheumatic, the douche in, 505
rheumatoid, 982
Articular rheumatism, acute, 967
chronic, 980
Artificial digestive agents, 708
Asepsis, 599
Asiatic cholera, massage in, 300
Assimilation of food, 632
Asthma, nervous, electricity in, 198
Ataxia, locomotor, electricity in, 191
massage in, 322
Atomization in medication, 38
Atomizer, vaseline, 835
Atrophy, progressive muscular, electricity in, 192
Avoirdupois weight, 57

B.

Bacteria and bacterial products in the treatment of tuberculosis, 872
pathogenic, which do not form spores, destruction of, 596
Balneology, 514
Balsam of tolu in tuberculosis, 833
Banting's treatment of obesity, 681
Bath, air, hot, 511
arsenical, in rheumatoid arthritis, 983
Brand, 491
cold, in the hyperpyrexia of acute articular rheumatism, 978
full, 491
graduated, 492
in pneumonia, 500
in typhoid fever, 494
half, 489
hot-air, 511
for hygienic purposes, 453
influence of, upon the blood, 473
mineral, in chronic articular rheumatism, 981
Bath, mud, 512
rain, 503
sand, 512
sheet, 475
shower, 503
sitz, 507
therapeutic indications for, 507
treatment, in rheumatoid arthritis, 986
vapor, 511
warm, 501
Bathing in rachitis, 953
in scrofulosis, 929
Battery, the, 214
Bead-inhaler, Richardson's, 829
Beef-essence, 648
tea, peptonized, 712
Benzoate of ammonium in tuberculosis, 840
of sodium in tuberculosis, 840
Benzoates in acute articular rheumatism, 975
in tuberculosis, 834
Benzoic acid in tuberculosis, 834
Beverages, alcoholic, in diabetes mellitus, 1021
in diabetes mellitus, 668
in gout, 990
Bichloride of mercury as a disinfectant, 587
Bionergy, 721
Bitter waters, 524
Bladder, tuberculosis of, 914
Blanket pack, hot, 486
Blistering in acute articular rheumatism, 968
Blood, influence of baths on the, 473
transfusion of, in diabetes mellitus, 1035
Boils in diabetes mellitus, 1033
Bones, deformities of, in rachitis, 966
tuberculosis of, 883
Boric acid as a disinfectant, 585
in tuberculosis, 840, 864
Bowels, influence of climate upon affections of, 450
Brain, tuberculous lesions of, 914
Bran bread in diabetes mellitus, 1019
Brand bath, 491
Bread in diabetes mellitus, 1017
bran, in diabetes mellitus, 1019
gluten, in diabetes mellitus, 1017
torrefied, in diabetes mellitus, 1020
Bright's disease, influence of climate upon, 444
Bromide of arsenic in diabetes mellitus, 1028
of potassium in diabetes mellitus, 1028
Bromine in tuberculosis, 830
Bromoform in tuberculosis, 879
Bronchitis in rachitis, 960
Browne's, Lennox, respirator-veil, 756
Buckwheat in diabetes mellitus, 1020
Buttermilk in diabetes mellitus, 1016

C.

Cacao-shells in diabetes mellitus, 1021
Cachet de pain, 100
Cachets, 100

Calcareous waters, 531
Calcium oxide as a disinfectant, 585
phosphate, acid, in tuberculosis, 867, 880
Camphor in tuberculosis, 839
Camphorated naphthol in tuberculosis, 880
Capsulæ, 102
Capsule-filler, 103
Capsules, 102
Carbohydrates in foods, 626
Carbolic acid in diabetes mellitus, 1029
as a disinfectant, 590
in tuberculosis, 879
Carbon dioxide inhalations in tuberculosis, 815
Carbuncles in diabetes mellitus, 1033
Cardiac action, reflex effects of cold upon, 465
Catarrh, gastric, acute, food in, 646
chronic, food in, 649
Catgut, chromicized, 608
Cavities of the body, use of water in the, 508
Cerata, 110
Cerates, 110
Cervical massage, 274
Chalybeate waters, 528
table of, 529
Chamber inhaler, 835
Chartæ, 116
Chemical incompatibility, 116
Chloride of gold as a disinfectant, 589
of zinc, as a disinfectant, 589
in tuberculosis, 880
Chlorinated lime as a disinfectant, 581
Chlorine as a disinfectant, 582
in tuberculosis, 831
Chloroform in tuberculosis, 831
Chlorosis, massage in, 309
Chocolate in diabetes mellitus, 1021
Cholera, Asiatic, massage in, 300
Chorea, electricity in, 174
Chromic acid as a disinfectant, 585
Chromicized catgut, 608
Chronic laryngitis, climatic change in, 437
tuberculosis, localized, 856
Circulation, effect of peripheral irritation upon, 462
Circulatory system, massage in diseases of the, 306
Citrate of iron in scurvy, 1007
Citric acid as a disinfectant, 585
in scurvy, 1007
Clarke's rule for dosage, 33
Clemens' solution in diabetes mellitus, 1028
Climate, 385
influence of, on affections of the stomach and bowels, 450
on Bright's disease, 444
on diabetes insipidus, 448
mellitus, 448, 1023
on dosage, 38
on gout, 995
on healthy kidneys, 447
on hepatic affections, 449
on phthisis, 415
on scrofulosis, 930
Climate, physics of, 385
physiology of, 396
Climates, classification of, 406
coast, 409
elevated, 412
inland, 409
island, 409
physiological effects of, 113
sea, 406
therapeutic applications of, 413
Climatic change, diseases indicating, 414, 436
treatment of phthisis, comparative results of, 425
Clothing in rachitis, 953
Coal-tar products as disinfectants, 590
Coast climates, 409
Cocoa in gout, 992
Codeine in diabetes mellitus, 1025
Cod-liver oil in rachitis, 954
in rheumatoid arthritis, 983
in scrofulosis, 942
administration of, 944
Coffee in diabetes mellitus, 1021
in gout, 992
Colchicum in gout, 998
Cold, application of, in acute articular rheumatism, 968
reflex effects of, upon cardiac action, 465
Collapsible tubes for ointments, 112
Collodia, 82
Collodions, 82
Coma in diabetes mellitus, 1034
Combining of drugs, 49
Complications of rachitis, 958
Compressed air, continuous respiration of, in tuberculosis, 807
expiration into, in tuberculosis, 807
inspiration of, in tuberculosis, 805
Compulsory vaccination, 558
Confectiones, 107
Confections, 107
Conium and ether in tuberculosis, 839
Constipation, food in, 658
in gout, treatment of, 996
by cascara sagrada, 996
by iridin, 996
massage in, 293
in rachitis, 959
in scrofulosis, 940
Consumption, galloping, 885
treatment of, 886
pulmonary, 884
final stages of, 924
slowly-extending lesions of, 892
tapping and draining of cavities in, 895
tendency to, in diabetes mellitus, 1033
Convalescence, food in, 645
Convulsions, general, in rachitis, 961
Corpulence, massage in, 305
Corrosive sublimate as a disinfectant, 587
Cowling's rule for dosage, 34
Craniotabes in rachitis, 965
Creasote in tuberculosis, 838, 860, 879
Creolin as a disinfectant, 591

Cupric sulphate as a disinfectant, 588
Cups, sanitary, for sputa in tuberculosis, 733
Cure, grape, 707
  koumiss, 704
  milk, 700
  rest, 227
  Swedish movement, 247
  whey, 700, 703
Current-differentiation, 148
Curvature of spine, lateral, massage in, 329
Cuspidors, sanitary, for sputa in tuberculosis, 733
Cyanide of mercury and zinc dressing, 610
Cystitis in diabetes mellitus, treatment of, 1033

D.

Dancel's treatment of obesity, 681
Death, method of, in disease, 23
Death, principal causes of, 541
Decocta, 86
Decoctions, 86
Decoction vessel, 87
Deformities of bones in rachitis, 966
Destruction of infectious material containing spores, 595
  of pathogenic bacteria which do not form spores, 596
Diabetes mellitus, 1009
  acetanilid in, 1030
  alcoholic beverages in, 1021
  alkaline waters in, 1026
  almond flour in, 1019
  antipyrine in, 1029
  arsenic in, 1027
    bromide in, 1028
  beverages in, 668, 1021
  boils in, 1033
  bran bread in, 1019
  bread in, 1017
    bran, in, 1019
    gluten, in, 1017
    torrefied, in, 1020
  bromide of arsenic in, 1028
    of potassium in, 1028
  buckwheat in, 1020
  buttermilk in, 1016
  cacao-shells in, 1021
  carbolic acid in, 1029
  carbuncles in, 1033
  chocolate in, 1021
  Clemens' solution in, 1028
  climate in, 448, 1023
  codeine in, 1025
  coffee in, 1021
  coma in, 1034
  cystitis in, treatment of, 1033
  diabetic coma in, 1034
  diarrhœa in, treatment of, 1032
  dietaries in, 667, 668, 669
  dietetic treatment of, 1012
  diet list, Austin Flint, Jr.'s, 1022
  ergot in, 1026
  etiology of, 1009
  exercise in, 1023
Diabetes mellitus; fats in, 1021
  fatty acids in, 1029
  food in, 661
    craving for, in, 1032
  fruits permitted in, 1020
  gangrene in, 1033
  gingivitis in, treatment of, 1031
  gluten flour in, modes of preparing, 1018
  glycerin as a substitute for sugar in, 1021
  glycina hispida, meal of, in, 1019
  honey as a substitute for sugar in, 1021
  intravenous injections of saline solution in, 1035
  inulin in, 1018
  iodoform in, 1028
  koumiss in, 1017
  lactic acid in, 1028
  lichenin in, 1018
  Martineau's treatment of, 1027
  medicinal treatment of, 1024
  milk in, 1015
  morphine in, 1025
  neuritis in, treatment of, 1033
  opium in, 1025
    alkaloids of, in, 1025
  oxygen in, 1030
  phenacetin in, 1030
  pilocarpine in, 1030
  potassium bromide in, 1028
  prophylactic treatment of, 1011
  saccharin as a substitute for sugar in, 1021
  salicylate of sodium in, 1029
  saline solution, intravenous injection in, 1035
  shell-fish allowed in, 1020
  skin, itching of, in, 1032
  sodium salicylate in, 1029
  sulphonal in, 1030
  tea in, 1021
  tendency to phthisis pulmonalis in, 1033
  thirst in, treatment of, 1031
  transfusion of blood in, 1035
  wheat-germs in, 1020
Diabetic coma in diabetes mellitus, 1034
Diagnosis, electricity as a means of, 152
Diarrhœa, food in, 659
  massage in, 299
  in rachitis, 958
  tendency to, in diabetes mellitus, 1032
Diathesis, scrofulous, treatment of, 942
Diet in acute articular rheumatism, 977
  in diabetes mellitus, 1012, 1015, 1022
  in gout, 987
  in rachitis, 954
  in scrofulosis, 932
  in tuberculosis, 759
Dietetic treatment of gout, 1000
  of rheumatoid arthritis, 984
Digestive agents, artificial, 708
  disturbances in rachitis, 958
  organs, food in diseases of, 646

Dilatation of stomach, food in, 654
Diphtheria, how specific cause of, enters body, 549
Disease, basal condition in, 24
cause of, 22
effect of, upon the action of medicines, 45
effect of emotions upon, 41
hydrotherapy in, 457
method of death in, 23
remedial forces in, 25
virus of, in the treatment of tuberculosis, 872
Diseases of the circulatory system, massage in, 306
in which climatic change is indicated, 414
of the eye, massage in, 335
of the female reproductive organs, massage in, 332
geographical distribution of, 401
of the heart and great vessels, climatic change in, 437
of the kidneys, climatic change in, 442
of the male reproductive organs, massage in, 333
of the nervous system, climatic change in, 439
massage in, 309
neuralgic, obstinate, the douche in, 505
preventable, 537
racial distinctions in, 401
of the respiratory system, massage in, 331
of the skin, electricity in, 202
massage in, 336
specific, how causes of, enter body, 548
diphtheria, 549
inflammatory rheumatism, 551
scarlet fever, 550
tuberculosis, 551
typhoid fever, 548
determining cause of entrance into body, 553
tubercular, restriction and prevention of, 570
Disinfectants, acids, 583
acetic, 585
boric, 585
chromic, 585
citric, 585
hydrochloric, 583
lactic, 585
nitric, 583
nitrous, 585
oxalic, 585
phosphoric, 585
salicylic, 585
sulphuric, 583
sulphurous, 583
tannic, 585
alkalies, 585
calcium oxide, 585
potash, 586
soda, 587
chloroform, 593
Disinfectants, coal-tar products, 590
aniline violet, 592
carbolic acid, 590
creolin, 591
kresol, 592
malachite green, 592
naphthol, 592
pyoktanin, 592
thymol, 592
essential oils as, 592
metallic salts, 587
arseniate of soda, 589
bichloride of mercury, 587
cupric sulphate, 588
ferrous sulphate, 590
gold chloride, 589
mercuric chloride, 587
silver nitrate, 589
zinc chloride, 589
sulphate, 590
oxidizing, 579
chlorinated lime, 581
chlorine, 582
hydrogen peroxide, 580
iodine, 582
terchloride, 582
iodoform, 582
iodol, 582
oxygen, 579
ozone, 580
peroxide of hydrogen, 580
potassium permanganate, 580
table of, 594
Disinfection, 573
physical agents in, 577
tests of, 574
Dog's blood, serum of, in tuberculosis, 871
Dosage, 29
age in, 33
Clarke's rule for, 33
Cowling's rule for, 34
of electricity, 138
influence of habits and climate in, 38
sex in, 33
Young's rule for, 34
Douche, the, in hydrotherapy, 502
in chronic inflammatory conditions, 505
in chronic rheumatic arthritis, 505
in dyspepsia, 505
in obesity, 506
in obstinate neuralgic conditions, 505
therapeutic indications for, 504
Drinking, water-, 510
Dripping sheet in hydrotherapy, 487
therapeutic indications for, 489
Dropsies, ovarian, massage in, 333
Dropsy, massage in, 307
Drugs, combination of, 53
combining of, 49
Dujardin-Beaumetz dietary in dyspepsia and indigestion, 657
Dyspepsia, Dujardin-Beaumetz dietary in, 657
the douche in, 505
food in, 654

Dyspepsia, Leube's dietary in, 657
massage in, 292
nervous, electricity in, 196
in rachitis, 958

E.

Earth, composition of, 386
configuration of the, 386
Ebstein's treatment of obesity, 682
Eggs as a food, 631
Electrical application, methods of, 155
Electricity, current differentiation in, 148
dosage of, 138
in gynecology, 204
as a means of diagnosis, 152
in obstetrics, 221
therapeutic action of, 133
in the treatment of neurotic anæsthesia, 199
of angina pectoris, 194
of asthma, 198
of chorea, 174
of dyspepsia, nervous, 196
of epilepsy, 175
of exophthalmic goitre, 178
of impotency, 200
of insanity, 195
of laryngeal nervous diseases, 204
of nervous asthma, 198
of nervous diseases, 169
of the larynx, 204
of nervous dyspepsia, 196
of neuralgia, 172
of neurasthenia, 170
of neuroses of special senses, 201
of neurotic anæsthesia, 199
of occupation neuroses, 192
of paralysis, 180
of paralysis agitans, 192
of posterior spinal sclerosis, 191
of progressive muscular atrophy, 192
of rheumatoid arthritis, 985
of shock, 166
of skin diseases, 202
of special sense neuroses, 201
of spinal sclerosis, posterior, 191
of torticollis, 193
Electrodes, external, 217
internal, 216
Electrolysis, 224
Electro-therapeutics, 133
Elevated climates, 412
Elixiria, 81
Elixirs, 81
Emaciation in scurvy, treatment of, 1007
Emotions, effect of, upon disease, 41
effect of, in therapeutics, 41
Empiricism in therapeutics, 17
Emplastra, 115
Endermic medication, 37
Endocarditis in acute articular rheumatism, treatment of, 977
Energy, reinforcement of, 736
vital, 721
Epilepsy, electricity in, 175
Ergot in diabetes mellitus, 1026
Essence, beef, 648
Ether and conium in tuberculosis, 839
Ethereal solutions, 82
Eucalyptol in tuberculosis, 835, 837
Evans's pocket inhaler, 836
Exercise in diabetes mellitus, 1023
general, 339, 384
in gout, 995
in tuberculosis, 769
Exophthalmic goitre, electricity in, 178
External electrodes, 217
Extracta, 96
fluida, 92
Extracts, 96
fluid, 92
malt, 708
Eyes, diseases of the, massage in, 335

F.

Faradization, general, 158
localized, 156
Fats in food, 626
in diabetes mellitus, 1021
Fatty acids in diabetes mellitus, 1029
Faults in prescription-writing, 127
Febrile maladies, alcohol in, 644
Bauer's dietary for, 641
beverages in, 643
Dujardin-Beaumetz dietary for, 641
eggs in, 641
food in, 636
milk in, 640
Feeding, forced, 699
rectal, 713
Female reproductive system, massage in diseases of the, 332
Ferrous sulphate as a disinfectant, 590
Fever, rheumatic, how specific cause of, enters body, 551
scarlet, how specific cause of, enters body, 550
typhoid, as influenced by water-supply and sewerage, 563
how specific cause of, enters body, 548
Fibroid phthisis, chronic, 893
Fistula in ano, 914
Fluid extracts, 92
Fluorine in tuberculosis, 832
Food accessories, 626
in acute disseminated tuberculosis, 852
in albuminuria, 669
in anæmic conditions, 696
assimilation and utilization of, 632
in cancer of stomach, 653
in constipation, 658
in convalescence, 645
craving for, in diabetes mellitus, 1032
in diabetes mellitus, 661
in diarrhœa, 659
in dilatation of stomach, 654
in diseases of the digestive organs, 646
in dyspepsia, 654
in febrile maladies, 636

Food in gastric cancer, 653
catarrh, acute, 646
chronic, 649
dilatation, 654
ulcer, 652
in gout, 674
in indigestion, 654
infants', Liebig's, 709
in leanness and defective nutrition, 688
in morbid states, 636
in obesity, 679
in phthisis, 693
in rachitis, 954
in scrofulosis, 932
stuffs, 629
in tuberculosis, 759
in uricæmia, 674
Foods, 625
animal, 629
malted, 708
peptonized, 710
predigested, 708
vegetable, 631
Forced feeding, 699
Franklinization, 164
Fruits permitted in diabetes mellitus, 1020
Full bath, 491
graduated, 492
in pneumonia, 500
in typhoid fever, 494
Fuller's lotion in acute articular rheumatism, 968
Functional derangement of liver, massage in, 300

G.

Gangrene in diabetes mellitus, 1033
Galvanization, central, 161
localized, 156
Gaseous injections, rectal, in tuberculosis, 824
Gasometer, Waldenburg's, 794
Gastric cancer, food in, 653
catarrh, acute, food in, 646
chronic, food in, 649
dilatation, food in, 654
ulcer, food in, 652
Gelatinous substances in nutrition, 626
General exercise, 339, 384
Generator, Wallian's oxygen, 854
Geographical distribution of disease, 401
Germain Sée's treatment of obesity, 685
Germicide inhalations and insufflations in tuberculosis, 840
Gibbes-Shurly treatment of tuberculosis, 876
Gingivitis in diabetes mellitus, treatment of, 1031
Glands, scrofulous, treatment of, 949
Glossary of terms and titles used in medicine, 62
Gluten flour, modes of preparing, 1018
Glycerin as a substitute for sugar in diabetes mellitus, 1021
Glycerita, 79
Glycerites, 79
Glycina hispida, meal of, in diabetes mellitus, 1019
Goitre, exophthalmic, 178
Gold chloride as a disinfectant, 589
iodide and manganese in tuberculosis, 877
and sodium chloride in tuberculosis, 846, 876
Gout, 987
acute, 996
treatment of, internal, 997
local, 997
alcohol in, 990
alkaline treatment of, 999
arsenic in, 996
beverages in, 990
climate in, 995
cocoa in, 992
coffee in, 992
colchicum in, 998
constipation in, treatment of, 996
by cascara sagrada, 996
by iridin, 996
diet in, 987
dietetic treatment of, 1000
exercise in, 995
food in, 674
iron in, 996
lithium in, 995
malt liquors in, 990
milk in, 991
medicinal treatment of the constitutional state in, 995
natural mineral waters in, 992
nutrition, treatment of the disordered state of, in, 987
potassium salts in, 996
retrocedent, treatment of, 1000
salicylates in, 999
tea in, 992
treatment of, 993
water in, 992
wines in, 990
Gouty arthritis, chronic, local treatment of, 1000
Grape cure, 707
Gums, spongy and bleeding, in scurvy, treatment of, 1007
Gymnastics, vocal, 331
Gynecology, electricity in, 204

H.

Habits, influence of, on dosage, 38
Hahnemannism, 18
Half bath, 489
Health service, national, 567
State boards of, 543
functions of, 566
Hernia, massage in, 302
Heart and great blood-vessels, diseases of, climatic changes in, 437
Hepatic affections, influence of climate upon, 449
Homœopathy, 18

Honey as a substitute for sugar in diabetes mellitus, 1021
Honeys, 77
Hot-air and vapor baths, 511
hot blanket pack, 486
pack, local, 487
wet, 486
Humidity, 392
Hydræmia, massage in, 309
Hydrocarbons, 626
Hydrochloric acid as a disinfectant, 583
Hydrocyanic acid in tuberculosis, 865
Hydrofluoric acid in tuberculosis, 880
Hydrogen dioxide in tuberculosis, 846, 879
peroxide as a disinfectant, 580
Hydrotherapy, 453
in disease, 457
in scarlet fever, 499
technique of, 473
Hygienic treatment of chronic articular rheumatism, 980
Hyperpyrexia in acute articular rheumatism, 978
cold baths in, 978
Hypodermic medication, 36
J. W. White's syringe for, 877
Hypophosphites in tuberculosis, 847, 866
Hypotrophy, 718
causes of, 724
therapeusis of, 737
Hysteria, rest-cure for, 227

I.

Ichthyol in articular rheumatism, acute, 968
chronic, 980
Idiosyncrasy, 43
Imperial measure, 57
Impotency, electricity in, 200
Incompatibilities, summary of, 126
Incompatibility, 116
chemical, 116
physical, 124
Indication, therapeutic, 22
Indigestion, food in, 654
Infants' food, Liebig's, 709
Inflammatory conditions, chronic, the douche in, 505
Inflammatory rheumatism, how specific cause of, enters the body, 551
Infectious material containing spores, destruction of, 595
Infusa, 84
Infusion-mugs, 85
Infusions, 84
Inhalations of carbon dioxide in tuberculosis, 815
and insufflations, germicide, in tuberculosis, 840
of nitrogen in tuberculosis, 818
monoxide in tuberculosis, 817
of powders in tuberculosis, 841
Inhaler, bead, Richardson's, 829
chamber, 835
Evans's pocket, 836
Injections, rectal, gaseous, in tuberculosis, 824
intrapulmonary, in tuberculosis, 889
Inland climates, 409
Insanity, electricity in, 195
Internal electrodes, 216
Intestinal obstruction, massage in, 302
Intrapulmonary injections in tuberculosis, 889
Intravenous injection of saline solution in diabetes mellitus, 1035
Intussusception, massage in, 302
Inulin in diabetes mellitus, 1018
Iodide of iron in rheumatoid arthritis, 985
of mercury in tuberculosis, 879
and potassium in tuberculosis, 879
Iodine as a disinfectant, 582
in rheumatoid arthritis, 985
terchloride as a disinfectant, 582
in tuberculosis, 876, 879
vapor in tuberculosis, 827
Iodoform in diabetes mellitus, 1028
as a disinfectant, 582
in tuberculosis, 830, 857
Iodol as a disinfectant, 582
in tuberculosis, 879
Iron in gout, 996
citrate of, in scurvy, 1007
iodide of, in rheumatoid arthritis, 985
in rheumatoid arthritis, 984
Irrigation of the stomach, 508
Irritation, peripheral, effect of, upon the circulation, 462
upon respiration, 462
upon temperature changes, 467
upon tissue-metamorphosis, 470
Island climates, 409
Itching of the skin in diabetes mellitus, 1032

J.

Joints, stiffened, in gout, treatment of, 1007
tuberculosis of, 883

K.

Kefyr, 706
relation of, to cow's milk, 707
Kidney diseases, climatic change in, 442
tuberculosis of the, 914
Koch's treatment of tuberculosis, 872
Koumiss, comparison of, with mare's milk, 706
composition of, 706
cure, 704
in diabetes mellitus, 1017
Kresol as a disinfectant, 592

L.

Lactic acid in diabetes mellitus, 1028
as a disinfectant, 585
Laryngismus stridulus in rachitis, 962
Laryngitis, chronic, climatic change in, 437

Larynx, nervous diseases of the, electricity in, 204
tubercular lesions of, 899
cocaine in, 907
local treatment of, 900
Lateral curvature of the spine, massage in, 329
sclerosis, massage in, 323
Latitude, 390
Leanness and defective nutrition, food in, 688
Lesions, tubercular, treatment of, 848
Leube's dietaries for diabetes mellitus, 657
meat-solution, 713
Leucocythæmia, massage in, 309
Lichenin in diabetes mellitus, 1018
Liebig's infants' food, 709
Light, 394
Lime, chlorinated, as a disinfectant, 581
Lime-juice in scurvy, 1006
Linimenta, 83
Liniments, 83
Liquores, 75
Lithium in gout, 995
sulpho-ichthyolate in chronic articular rheumatism, 981
Liver, functional derangement of, massage in, 300
influence of climate on affections of, 449
Localized tuberculosis, acute, 856
chronic, 856
Locomotor ataxia, electricity in, 191
massage in, 322
Lupus, 881

M.

Malachite green as a disinfectant, 592
Malt extracts, 708
liquors in gout, 990
Malted foods, 708
Manganese and gold chloride in tuberculosis, 877
Martineau's treatment of diabetes mellitus, 1027
Massage, 261
abdominal, 276
in anæmia, 309
applications of, therapeutic, 291
in Asiatic cholera, 300
in ataxia, locomotor, 322
cervical, 274
in chlorosis, 309
in cholera, Asiatic, 300
in circulatory system, diseases of the, 306
in constipation, 293
in corpulence, 305
in cramp, writers', 324
in curvature of spine, lateral, 329
in diarrhœa, 299
in diseases of the circulatory system, 306
eyes, 335
nervous system, 309
reproductive organs, female, 332
male, 333
Massage in diseases of the respiratory system, 331
skin, 336
urinary organs, 333
in dropsy, 307
ovarian, 333
in dyspepsia, 292
in eyes, diseases of the, 335
in female reproductive organs, diseases of the, 332
in functional derangement of the liver, 300
in hernia, 302
in hydræmia, 309
in intestinal obstruction, 302
in intussusception, 302
in lateral curvature of the spine, 329
sclerosis, 323
in leucocythæmia, 309
in liver, functional derangements of the, 300
in locomotor ataxia, 322
in muscular rheumatism, 325
in myalgia, 325
in narcotic poisioning, 336
in nervous affections, paralytic, 321
spasmodic, 323
system, diseases of the, 309
in neurasthenia, 316
in obesity, 305
in obstruction, intestinal, 302
in ovarian dropsies, 333
in paralysis, pseudo-hypertrophic muscular, 322
in paralytic nervous affections, 321
in poisoning, narcotic, 336
in scurvy, general, 1007
physiological effects of, 283
in pseudo-hypertrophic muscular paralysis, 322
in reproductive organs, diseases of the, female, 332
male, 333
in respiratory system, diseases of the, 331
in rheumatism, muscular, 325
in sclerosis, lateral, 323
in skin, diseases of the, 336
in spasmodic nervous affections, 323
in spine, lateral curvature of, 329
in sprains, 326
therapeutic applications of, 291
in urinary organs, diseases of the, 333
in writers' cramp, 324
Meals frequency of, in tuberculosis, 765
Measure, apothecaries', 57
imperial, 57
wine, 57
Measures, 57
domestic, 58
Meat peptones, 711
powdered raw, 700
solution, Leube's, 713
Mechano-therapy, 339
Medicated waters, 73
wines, 91

Medication, endermic, 37
hypodermic, 36
prophylactic, in tuberculosis, 842
in pyrexia of tuberculosis, 869
rectal, 35
Medicinal agents, impregnation of the air with, in tuberculosis, 821
Medicinal treatment of the constitutional state in gout, 995
of diabetes mellitus, 1024
of rachitis, 954
of rheumatoid arthritis, 984
Medicine, terms and titles used in, 62
Mellita, 77
Meninges, tuberculous lesions of, 914
Menthol in tuberculosis, 837, 879
Mercuric chloride as a disinfectant, 587
in tuberculosis, 841, 846, 879
iodide in tuberculosis, 879
Metallic salts as disinfectants, 587
Methyl violet in tuberculosis, 879
Metric system in prescription-writing, 59
Milk as a food, 630
cure, 700
in diabetes mellitus, 1015
in gout, 991
gruel, peptonized, 712
peptonized, 711
predigestion of, partial, in scrofulosis, 935
Milliampèremeter, 139, 216
Mineral waters, classification of, 519
drinking of, 517
natural, in gout, 992
uses of, 518
springs, 514
substances as foods, 626
Misturæ, 78
Mitchell's, S. Weir, treatment of obesity, 685
Mixtures, 78
Morbid states, food in, 636
Morbility statistics, 539
Morbus coxæ, 883
Morphine in diabetes mellitus, 1025
Mortality from phthisis, effect of altitude on, 420
statistics, 540, 556
Movements, Swedish, 247
Mucilages, 78
Mucilagines, 78
Mud-baths, 512
Muscular atrophy, progressive, electricity in, 192
rheumatism, massage in, 325
Musk in tuberculosis, 839
Myalgia, massage in, 325

N.

Naphtha in tuberculosis, 838
Naphthol as a disinfectant, 592
camphorated, in tuberculosis, 880
Narcotic poisoning, massage in, 336
Nasal passages, tuberculosis of, 908
National health service, 567
Nebulizer, Oliver's, 831
Nervous affections, paralytic, massage in, 321
spasmodic, massage in, 323
asthma, electricity in, 198
complications in rachitis, 961
diseases, electricity in, 169
of the larynx, electricity in, 204
dyspepsia, electricity in, 196
system, climatic changes in diseases of the, 439
massage in diseases of the, 309
Neuralgia, electricity in, 172
Neuralgic diseases, obstinate, the douche in, 505
Neurasthenia, climatic change in, 439
electricity in, 170
massage in, 316
rest-cure in, 227
Neuritis in diabetes mellitus, treatment of, 1033
Neuroses, occupation, electricity in, 192
special sense, electricity in, 201
Nitrate of silver as a disinfectant, 589
Nitric acid as a disinfectant, 583
Nitrogen, inhalations of, in tuberculosis, 818
monoxide, inhalations of, in tuberculosis, 817
Nitrous acid as a disinfectant, 585
Nutrition and foods, 625
defective, food in, 688
disordered state of, in gout, treatment of, 987
gelatinous substances in, 626

O.

Obesity, the douche in, 506
food in, 679
massage in, 305
treatment of, Banting's, 681
Dancel's, 681
Ebstein's, 682
Germain Sée's, 685
Mitchell's, S. Weir, 685
Oertel's, 683
Schweninger's, 685
Obstetrics, electricity in, 221
Obstruction, intestinal, massage in, 302
Oertel's treatment of obesity, 683
Ointments, 111
collapsible tubes for, 112
Oleaginous solutions, 83
Oleata, 84
Oleates, 84
Oleoresinæ, 95
Oleoresins, 95
Oliver's nebulizer, 831
Opium in diabetes mellitus, 1025
alkaloids of, in diabetes mellitus, 1025
in tuberculosis, 839
Osseous system, condition of, in rachitis, 965
Ovarian dropsies, massage in, 333
Oxalic acid as a disinfectant, 585
Oxide of calcium as a disinfectant, 585

Oxygen in diabetes mellitus, 1030
as a disinfectant, 579
generator, Wallian's, 854
in respired air in tuberculosis, diminution of, 813
in tuberculosis, 780
Ozone, 390
as a disinfectant, 580

P.

Pack, hot blanket, 486
therapeutic indications for, 486
local, 487
wet, 486
wet, 477
as an antifebrile agent, 481
application of, 477
cot for, 478
first stage of, 478
second stage of, 479
complete, 479
therapeutic indications for, 483
Packs, partial, 483
abdominal compress, 483
Pancreatin, 710
Papers (in pharmacy), 116
Paracentesis in pneumothorax and tubercular pleurisy, 898
Paralysis, electricity in, 180
agitans, electricity in, 192
pseudo-hypertrophic muscular, massage in, 322
Paralytic nervous affections, massage in, 321
Pathogenic bacteria, destruction of, 596
Pepsin, 710
Peptonized beef-tea, 712
foods, 710
milk, 711
gruel, 712
Pericarditis in acute articular rheumatism, treatment of, 977
tuberculous, 899
Peripheral irritation, effect of, on circulation, 462
on respiration, 462
influence of, on temperature-changes, 467
on tissue-metamorphosis, 470
Peritoneum, chronic tuberculosis of, 913
tubercular lesions of, 909
operation in, 910
treatment of, 912
tuberculosis of, chronic, 913
Permanganate of potassium as a disinfectant, 580
Pharynx, tuberculosis of the, 899
Phenacetin in acute rheumatism, 974
in diabetes mellitus, 1030
Phenazonum in acute rheumatism, 975
Phosphate of calcium, acid, in tuberculosis, 867
of sodium in tuberculosis, 867
Phosphoric acid as a disinfectant, 585
Phosphorus in rachitis, 955
Phthisical cavities, tapping and draining of, 895
Phthisis, altitude treatment of, cases suited for, 435
contraindications, 433
effect on mortality, 420
indications for, 433
chronic fibroid, 893
climatic treatment of, comparative results of, 425
effect of, 415
result of, 430
final stages of, 924
florida, 885
treatment of, 886
food in, 693, 757
pulmonalis, tendency to, in diabetes mellitus, 1033
Physical incompatibility of drugs, 124
Physiological effects of climate, general, 413
of massage, 283
Pigeon-breast in rachitis, 966
Pill machine, 108
tile, 108
Pills, 107
coatings for, 109
compressed, 109
sugar-coated, 109
Pilulæ, 107
Pilocarpine in diabetes mellitus, 1030
Plaster-spreading, 115
Plasters, 115
Pleura, the, in pulmonary tuberculosis, 897
Pneumatic apparatus, physiologic effects of the, 804
chambers, 791
Pneumonia, graduated full bath in, 500
Pneumotherapy, artificial, in tuberculosis, 790
modifications of density in, 790
S. Solis-Cohen's apparatus for, 796
Pneumothorax, 898
Pocket inhaler, Evans's, 836
Poisoning, narcotic, massage in, 336
Post-mortem appearances in scurvy, 1005
Posterior spinal sclerosis, electricity in, 191
Potash as a disinfectant, 586
in scurvy, 1006
Potassio-mercuric iodide in tuberculosis, 879
Potassium bromide in diabetes mellitus, 1028
permanganate as a disinfectant, 580
salts in gout, 995
Potts' disease, 883
Powders, 99
inhalation of, in tuberculosis, 841
Practical sanitation, scientific basis for, 556
Predigested foods, 708
Preparation of sponges for surgical use, 609
Prescription, model of a, 56

Prescription-writing, 53
faults in, 127
Prescriptions, 53
magistral, 53
metric system in, 59
official, 53
Progressive muscular atrophy, electricity in, 192
Prophylactic medication in tuberculosis, 842
Prophylaxis of rachitis, 952
Pseudo-hypertrophic muscular paralysis, massage in, 322
Pulmonary cavities, surgical treatment of, 894
consumption, 884
slowly-extending lesions of, 892
lesions of tuberculosis, 884
tuberculosis, the pleura in, 897
Purgative waters, 524
Pulveres, 99
Pyoktanin as a disinfectant, 592
in tuberculosis, 879
Pyrexia of tuberculosis, medication in the, 869

R.

Rachitis, 951
bathing in, 953
bones, long, deformities of, in, 966
bronchitis in, 960
clothing in, 953
cod-liver oil in, 954
complications of, 958
nervous, 961
thoracic, 960
constipation in, 959
convulsions, general, in, 961
craniotabes in, 965
deformities of long bones in, 966
diarrhœa in, 958
digestive disturbances in, 958
dyspepsia in, 958
food in, 954
laryngismus stridulus in, 962
medicinal treatment of, 954
nervous complications in, 961
osseous system, state of, in 965
phosphorus in, 955
pigeon-breast in, 966
prophylaxis of, 952
spinal curvatures in, 966
tetany in, 964
thoracic complications in, 960
treatment of, general, 952
medicinal, 954
Racial distinctions, 401
Rain-bath, 503
Rectal feeding, 713
injections, gaseous, in tuberculosis, 825
medication, 35
Reinforcement of vital energy, 736
Remedial forces in disease, 25
Remedies, method and time of administration of, 34
Reproductive system, female, massage in diseases of the, 332
male, massage in diseases of the, 333
Resins, 98
Resorcin in tuberculosis, 879
Respiration, effect of peripheral irritation on the, 462
Respirator, Yeo's, 828
veil, Lennox Browne's, 756
Respiratory system, massage in diseases of the, 331
Rest in acute articular rheumatism, 967
in tuberculosis, 773
cure for neurasthenia and hysteria, 227
diet in, 236
difficulties, special, in, 241
electricity in, 239
exercise, active, after, 244
isolation in, 232
massage in, 237
medicines in, 240
in melancholia, 246
rest in, 234
schedule for, 245
treatment, duration of the, 245
Retrocedent gout, treatment of, 1000
Rheostat, 216
Rheumatic arthritis, chronic, the douche in, 505
Rheumatism, articular, acute, 967
acetanilide in, 974
alkaline treatment of, 976
antipyrine in, 974
benzoates in, 975
benzoic acid in, 975
blistering in, 968
cold applications in, 968
diet in, 977
endocarditis in, treatment of, 977
Fuller's lotion in, 968
hyperpyrexia in, 978
cold baths in, 978
ichthyol in, 968
pericarditis in, treatment of, 977
phenacetin in, 974
phenazonum in, 975
rest in, 967
salicylic acid, in, 969
action in mode of, 972
administration of, 973
dose of, 973
influence of, on pain and joint inflammation, 969
in preventing cardiac manifestations, 970
hyperpyrexia, 971
relapses, 971
on pyrexia, 969
untoward effects of, 971
salol in, 974
splints in, 968
treatment of, alkaline, 976
effect of, in preventing cardiac complications, 976
internal, 968
local, 968

Rheumatism, articular, acute, visceral complications in, treatment of, 977
chronic, 980
baths, mineral, in the treatment of, 981
general measures in, 980
ichthyol in, 980
sulpho-ichthyolate of lithium in, 981
of zinc in, 981
treatment of, hygienic, 980
local, 981
inflammatory, how specific cause of enters body, 551
muscular, massage in, 325
Rheumatoid arthritis, 982
arsenic in, 983
arsenical baths in, 983
bath treatment of, 986
cause of, 982
cod-liver oil in, 983
dietetic treatment of, 984
electricity in, 985
iodide of iron in, 985
iodine in, 985
iron in, 984
medicinal treatment of, 984
salicylates in, 984
treatment of, 983
bath, 986
dietetic, 984
medicinal, 984
Richardson's bead-inhaler, 829
syringe, automatic, 891
Roussel's treatment of tuberculosis, 875

S.

Saccharin as a substitute for sugar in diabetes mellitus, 1021
Salicylate of sodium in diabetes mellitus, 1029
Salicylates in gout, 999
in rheumatoid arthritis, 984
Salicylic acid in acute articular rheumatism, 969
as a disinfectant, 585
Saline solution, intravenous injection of, in diabetes mellitus, 1035
waters, 522
Salol in acute articular rheumatism, 974
in tuberculosis, 880
Salts, metallic, as disinfectants, 587
Sand-baths, 512
Sanitary cuspidors for sputa in tuberculosis, 733
Sanitation, cleanliness in, 545
general, 535
practical, scientific basis for, 556
views on, old and new, 544
Scarlet fever, how specific cause of enters body, 550
hydrotherapy in, 499
Schweninger's treatment for obesity, 683
Scleroses, lateral, massage in, 323
spinal, posterior, electricity in, 191
Scrofulosis, 927
anæmia in, 949
bathing in, 929
climate in, 930
constipation in, 940
diet in, 932
milk, partially predigested, in, 935
prophylaxis of, 927
Scrofulous diathesis, treatment of, 942
glands, treatment of, 949
Scurvy, 1001
citrate of iron in, 1007
citric acid in, 1007
diet in, 1007
emaciation in, treatment of, 1007
gums, spongy and bleeding, in, treatment of, 1007
history of, 1001
joints, stiffened, in, treatment of, 1007
lime-juice in, 1006
massage, general, in, 1007
nature of, 1001
post-mortem appearances in, 1005
potash in, 1006
prevalence, 1001
symptoms of, 1004
treatment of, 1006
vinegar in, 1007
Sea-climates, 406
Serum of dog's blood in tuberculosis, 871
Sewerage, influence of, on typhoid fever, 563
Sheet-bath, 475
dripping, 487
therapeutic indications for, 489
Shell-fish allowed in diabetes mellitus, 1020
Shock, treatment of, by electricity, 166
Shower-bath, 503
Shurly and Gibbes' treatment of tuberculosis, 876
Silver nitrate as a disinfectant, 589
Sitz bath, 507
therapeutic indications for, 507
Skin, itching of the, in diabetes mellitus, 1032
tuberculosis of the, 881
diseases, electricity in, 202
massage in, 336
Soda as a disinfectant, 587
Sodium arseniate as a disinfectant, 589
benzoate in tuberculosis, 840
chloride waters, 522
phosphate in tuberculosis, 867
salicylate in diabetes mellitus, 1029
Solutions, 75
alcoholic, 80
aqueous, 73
ethereal, 82
oleaginous, 83
Spasmodic nervous affections, massage in, 323
Special senses, neuroses of the, electricity in, 201
Specific diseases, mode of entrance of determining cause of, into body, 553

Spinal curvatures in rachitis, 966
sclerosis, posterior, electricity in, 191
Spine, lateral curvature of, massage in, 329
Spirits, 80
Splints in acute articular rheumatism, 968
Sponges, preparation of, for surgical purposes, 609
Sprains, massage in, 326
Springs, mineral, 514
Sputa, care of, in tuberculosis, 732
sanitary cuspidors for, 733, 734
Stabile application of electricity, 156
State boards of health, 543
functions of, 566
Statistics, morbility, 539
mortality, 540, 556
Stomach, cancer of, food in, 653
catarrh of, acute, food in, 646
chronic, food in, 649
climatic influence upon affections of the, 450
dilatation of, food in, 654
irrigation of the, 508
ulcer of, food in, 652
Strychnine in tuberculosis, 845
Sulphate of copper as a disinfectant, 588
of iron as a disinfectant, 590
Sulpho-ichthyolate of lithium in chronic articular rheumatism, 981
of zinc, in chronic articular rheumatism, 591
Sulphonal in diabetes mellitus, 1030
Sulphur dioxide as a disinfectant, 583
Sulphuretted waters, 526
Sulphuric acid as a disinfectant, 583
Sulphurous acid as a disinfectant, 583
vapors in tuberculosis, 823
Summary of incompatibilities, 126
Superalimentation in tuberculosis, 763
Suppositories, 113
Suppository-mould, 113
Suralimentation, 699
Swedish-movement cure, 249
Swedish movements, 247
Surgical treatment of pulmonary cavities, 894
Symptoms, special, of tuberculosis, treatment of, 848
Syringe, Richardson's automatic, 891
J. B. White's, for hypodermic medication, 877
Syrups, 76

T.

Tabellæ, 104
Tablet-triturates, 104
Tannic acid as a disinfectant, 585
Tannin in tuberculosis, 864
Tapping and draining of phthisical cavities, 895
Tar-vapor in tuberculosis, 837
Tea in diabetes mellitus, 1021
in gout, 992
Temperament, 43
Temperaments, classification of, 43
Temperature-changes, influence of peripheral irritation on, 467
Terebene in tuberculosis, 835
Terms and titles used in medicine, glossary of, 62
Testicle, tuberculous lesions of, 914
Tetany in rachitis, 964
Therapeusis of hypotrophy, 737
Therapeutic action of electricity, 133
applications of climatology, 413
of massage, 291
considerations, general, 17
indications for hot blanket pack, 486
for wet pack, 483
methods, 17
empiricism in, 17
Therapeutics, scientific method in, 21
Thermal waters, 532
Thirst in diabetes mellitus, treatment of, 1031
Thoracic complications in rachitis, 960
expansion in tuberculosis, 787
Thymol as a disinfectant, 592
in tuberculosis, 837, 863
Thymol-iodine in tuberculosis, 879
Tinctures, 88
Tissue-metamorphosis, effects of peripheral irritation on, 470
Tongue, tuberculous ulceration of, 908
Topical applications in tuberculosis, 879
Torticollis, electricity in, 193
Toxæmia in tuberculosis, treatment of, 848, 857
Transfusion of blood in diabetes mellitus, 1035
Triturates, tablet, 104
machine for making, 105
Triturations, 100
Treatment of articular rheumatism, acute, alkaline, 976
internal, 968
local, 968
chronic, hygienic, 980
local, 981
of cystitis in diabetes mellitus, 1033
of diabetes mellitus, dietetic, 1012
Martineau's, 1027
medicinal, 1024
prophylactic, 1011
of diarrhœa in diabetes mellitus, 1032
of gingivitis in diabetes mellitus, 1031
of gout, 993
of itching of skin in diabetes mellitus, 1032
of neuritis in diabetes mellitus, 1033
of rheumatoid arthritis, 983
of scurvy, 1006
of thirst in diabetes mellitus, 1031
of tuberculosis, acute disseminated, 853
Troches, 106
Troy weight, 57
Tubercular diseases, restriction and prevention of, 570
pulmonary lesions, 884
Tuberculin in tuberculosis, 872
Tuberculosis, 715

Tuberculosis, acid, calcium phosphate in, 867, 880
acute disseminated, 849
food in, 852
treatment of, 853
air in, 753
altitude in, 783
ammonium benzoate in, 840
arsenic in, 845
artificial pneumotherapy in, 790
avoidance of infection in, 730
balsam of tolu in, 833
bed-sores in, 924
benzoates in, 834
benzoic acid in, 834
of bladder and urethra, 914
of bones and joints, 883
boric acid in, 840, 864
of brain and meninges, 914
bromine in, 830
bromoform in, 879
camphor in, 839
camphorated naphthol in, 880
carbolic acid in, 879
cause of, specific, how it enters body, 551
chloride of zinc in, 880
chlorine in, 831
chloroform in, 831
clothing in, 755
cocaine in laryngeal, 907
compressed air, continuous respiration of, in, 807
expiration into, in, 807
inspiration of, in, 805
cough in, 920
creasote in, 838, 860, 879
diarrhœa in, 921
diet-list in, 759
ether and conium in, 839
eucalyptol in, 835, 837
exercise in, 769
of fauces and contiguous strictures, 899
fever in, 915
fluorine in, 832
food in, 757
forms of, 727
germicide inhalations and insufflations in, 840
Gibbes-Shurly treatment of, 876
gold and sodium chloride in, 846, 876
gold iodide and manganese in, 877
hæmoptysis in, 916
hydrocyanic acid in, 865
hydrofluoric acid in, 880
hydrogen dioxide in, 846, 879
hypophosphites in, 847, 866
in infancy, care of, 738
inhalations of powders in, 841
insomnia in, 921
iodine in, 876, 879
iodine vapor in, 827
iodoform in, 830, 857
iodol in, 879
of kidneys, 914
Koch's treatment of, 872
of larynx, 899
Tuberculosis of larynx, cocaine in, 907
treatment of, local, 900
lesions in, treatment of, 878
light in, 754
localized, acute, 856
chronic, 856
meals in, frequency of, 765
medication in, prophylactic, 842
in pyrexia, 869
of meninges, 914
meningitis in, 915
menthol in, 837, 879
mercuric chloride in, 841, 846, 879
iodide in, 879
potassic iodide in, 841
methyl violet in, 879
musk in, 839
naphtha in, 838
of nasal passages, 908
night-sweats in, 919
œdema in, 923
opium in, 839
oxygen in, 780
pain in, 922
of pericardium, 899
of peritoneum, 909
operation in, 910
treatment of, 912
chronic, 913
of pharynx, fauces, etc., 899
phlebitis in, 924
pneumatic chambers in, 791
potassio-mercuric iodide in, 879
preventive régime, 743
prophylactic medication in, 842
prophylaxis of, 729
pulmonary, the pleura in, 897
pyoktanin in, 879
pyrexia in, medication of, 869
rarefied air in, expiration into, 808
inspiration of, 807
rectal gaseous injections in, 825
residence in, 744
rest in, 773
resorcin in, 879
Roussel's treatment of, 875
salol in, 880
serum of dog's blood in, 871
Shurly-Gibbes treatment of, 876
of skin, 881
sodium benzoate in, 840
phosphate in, 867
specific cause of, how enters body, 551
sputa, care of, in, 732
sanitary cuspidors for, in, 733
strychnine in, 845
sulphurous vapors in, 823
superalimentation in, 763
symptoms of, special, 915
treatment of, 848
tannin in, 864
tar-vapor in, 837
terebene in, 835
of testicle, 914
thoracic expansion in, 787
thymol in, 837, 863, 880

Tuberculosis, thymol iodine in, 879
topical applications in, 879
toxæmia in, treatment of, 848, 857
treatment of, by bacteria, bacterial products, and virus of disease, 872
tuberculin in, 872
turpentine in, 834
of urethra, 914
of vagina and vulva, 914
vocation, choice of, in, 779
vomiting in, 922
water in, external application of, 768
as a food in, 767
Tuberculous lesions, treatment of, 848
Tubes, collapsible, for ointments, 112
Turpentine in tuberculosis, 834
Typhoid fever as influenced by water-supply and sewerage, 563
graduated full bath in, 494
how specific cause of enters body, 548

U.

Ulcer, gastric, food in, 652
Unguenta, 111
Uricæmia, food in, 674
Urethra, tuberculosis of, 914
Urinary organs, massage in diseases of the, 333
Uterus, operative electrical procedures on, 218

V.

Vaccination, compulsory, 558
Vagina, tuberculosis of the, 914
Vapor-baths, 511
of tar, in tuberculosis, 837
Vaseline, atomizer for, 835
Vegetable foods, 631
Vina medicata, 91
Vinegar in scurvy, 1007
Vinegars, 87
Violet, aniline, as a disinfectant, 592
Virus of disease in treatment of tuberculosis, 872
Visceral complications in acute articular rheumatism, treatment of, 977
Vital energy, 721
reinforcement of, 736
Vocal gymnastics, 331
Vocation, choice of, in tuberculosis, 779
Vulva, tuberculosis of the, 914

W.

Wafers, 100
Waldenburg's gasometer, 794
Wallian's oxygen generator, 854
Warm bath, 501
Water, action of, general conclusions upon, 512
rationale of the, 460
composition of, 387, 392
Water, drinking, 510
as a food, 626, 628
in tuberculosis, 767
in gout, 992
supply and sewerage, influence of, on typhoid fever, 563
in tuberculosis, external application of, 768
as a food in, 767
use of, in cavities of the body, 508
Waters, acidulous, 530
alkaline, 519
comparative chart of, 521
in diabetes mellitus, 1026
bitter or purgative, 524
calcareous, 531
chalybeate, 528
chart of, 529
medicated, 73
mineral, classification of, 518
drinking of, 517
natural, in gout, 992, 993
uses of, 518
purgative, 524
saline, 522
comparative chart of, 523
sodium chloride, 522
sulphuretted, 526
thermal, 532
Weight, apothecaries', 57
avoirdupois, 57
troy, 57
Weights and measures, 56
Wet pack, the, 477
as an antifebrile agent, 481
hot, 486
therapeutic indications for, 486
therapeutic indications for, 483
Wheat-germs in diabetes mellitus, 1020
Whey, composition of, 703
cure, 700
preparation of, 704
White swelling, 883
White's, J. B., syringe for hypodermic medication, 877
Winds, mountain and valley, 391
Wine measure, 57
Wines in gout, 990
medicated, 91
Writers' cramp, massage in, 324
Nussbaum's bracelet for, 324

Y.

Yeo's respirator, 828
Young's rule for dosage, 34

Z.

Zinc chloride as a disinfectant, 589
in tuberculosis, 880
sulphate as a disinfectant, 590
sulpho-ichthyolate in chronic articular rheumatism, 981

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With the close of the chapter just referred to (*Vertebral Artery*, Ligature of the, Heath's "Dictionary of Practical Surgery," vol. II., page 786), my interest in epilepsy did not cease. Indeed, at the time the article referred to was written, most of the investigations and operations now about to be described were complete, and time alone was wanting to realise their value. Sufficient time has now elapsed to test results, and these results are so encouraging and so interesting that I do not think I should withhold them any longer from the profession.

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